

Geometry Honors Unit 5: Circles (Gr. 9 - 10)

Content Area: **Mathematics**
Course(s): **Geometry Honors**
Time Period: **4th Marking Period**
Length: **6 Weeks**
Status: **Published**

Unit Overview

This unit opens with a review of circle vocabulary that is already familiar to students and the introduction of new terminology, symbols, and properties related to circles. Students will learn about the properties of tangents of circles and the relationships between the angles, arcs, and lengths of segments formed by radii, chords, secants and tangents of circles. In addition to this, students will use proportional reasoning to find the arc lengths and areas of sectors of circles, leading to the definition of radian measure. Students will also learn to graph and write equations of circles in the coordinate plane.

Transfer

Students will be able to independently use their learning to...

- Use the relationships between the angles, arcs, and segments of circles to solve applied problems.
- Construct polygons inscribed in circles.
- Write and graph equations of circles.

Meaning

Understandings

Students will understand that...

- Arcs lengths are portions of the circumference of a circle.
- Sector areas are portions of the area of a circle.
- Relationships exist between the angle and arc measures of circles.
- Relationships exist between the arc measures and lengths of segments associated with circles.
- Angles can be measured in degrees or radians.
- The equation of a circle is derived from the Pythagorean Theorem.

Essential Questions

Students will keep considering...

- How can geometric concepts and figures be described by careful use of geometric language?
- How can geometric concepts and figures be used to model real-world phenomena?
- How are the relationships between the angles, arcs, and segments of circles applied in solving problems?
- How should I decide what method to use when solving problems involving circles?
- How can I inscribe regular polygons in circles?
- How can I write the equation of a circle in the coordinate plane?

Application of Knowledge and Skill

Students will know...

- The definitions of the terminology related to circles.
- That the relationships that exist between the angles, segments, and arcs associated with circles can be used to solve for unknown measures.
- That arcs and sectors of circles represent a portions of the circle.
- That equations can be written to describe circles in the coordinate plane.

Students will be skilled at...

- Using the relationships between angles, arcs and segments of circles to solve for unknown measures.
- Calculating arc lengths and areas of sectors of circles.
- Writing and graphing equations of circles in the coordinate plane.

Academic Vocabulary

- adjacent arcs
- arc
- arc length
- central angle
- chord

- common tangent
- concentric circles
- congruent arcs
- congruent circles
- exterior of a circle
- external secant segment
- inscribed angle
- intercepted arc
- interior of a circle
- major arc
- minor arc
- point of tangency
- secant
- secant segment
- sector of a circle
- sector of a circle
- segment of a circle
- semicircle
- subtend
- tangent circles
- tangent of a circle
- tangent segments

Learning Goal 5.1

Students will understand and apply theorems about circles.

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Target 5.1.1 (Level of Difficulty: Retrieval, DOK: 1 - recall)

SWBAT define and identify each of the following terms associated with circles, as well as their symbolic notations:

- tangents
- secants
- chords
- arcs
- minor arcs
- major arcs
- semicircles
- central angles
- sectors of circles

- inscribed angles

MA.K-12.6	Attend to precision.
LA.RST.9-10.4	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.
MA.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords.

Target 5.1.2 (Level of Difficulty: Retrieval, DOK: 3 - Strategic Thinking)

SWBAT describe and use properties of tangents to verify relationships within circles and solve for unknowns.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords.

Target 5.1.3 (Level of Difficulty: Retrieval/executing, DOK: 3 - Strategic Thinking)

SWBAT construct a tangent line from a point outside a given circle to the circle.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.G-CO.D.12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
MA.G-C.A.4	Construct a tangent line from a point outside a given circle to the circle.

Target 5.1.4 (Level of Difficulty: Retrieval/executing, DOK: 2 - Skill)

SWBAT describe and apply the relationships between arcs, central angles, chords, and radii in solving for unknowns.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.7	Look for and make use of structure.
MA.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords.

Target 5.1.5 (Level of Difficulty: Retrieval/executing, DOK: 2 - Skill)

SWBAT use the relationships between inscribed angles and their intercepted arcs to solve for unknowns.

Theorems to include:

- The measure of an inscribed angle is half the measure of its intercepted arc.
- Inscribed angles on a diameter are right angles.
- Opposite angles of a quadrilateral inscribed in a circle are supplementary. (And proof of this)

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.7	Look for and make use of structure.
MA.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords.
MA.G-C.A.3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

Target 5.1.6 (Level of Difficulty: Retrieval/executing, DOK: 2 - Skill)

SWBAT find the measures of angles and arcs defined by secants, chords and tangents of circles.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.7	Look for and make use of structure.
MA.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords.

Target 5.1.8 (Level of Difficulty: Retrieval/executing, DOK: 2 - Skill)

SWBAT find the lengths of segments formed when tangents, secants, and chords intersect circles, and will use these relationships to solve problems.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.4	Model with mathematics.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords.

Learning Goal 5.2

SWBAT find arc lengths and areas of sectors of circles.

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Target 5.2.1 (Level of Difficulty: Retrieval/executing, DOK: 2 - Skill)

SWBAT find arc lengths and areas of sectors of circles.

<http://www.youtube.com/watch?v=0JHEqBLG650>

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.4	Model with mathematics.
MA.K-12.7	Look for and make use of structure.
MA.G-C.B.5	Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Target 5.2.2 (Level of Difficulty: Retrieval to Comprehension, DOK: 1 - recall)

SWBAT define radian measure and convert between radian and degree measure.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.G-C.B.5	Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Learning Goal 5.3

Students will translate between the geometric description and the equation for a circle.

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Target 5.3.1 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)

SWBAT use the Pythagorean Theorem to derive the equation of a circle. Given their center and radius, SWBAT write equations of circles in the coordinate plane.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.7	Look for and make use of structure.
MA.G-GPE.A.1	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Target 5.3.2 (Level of Difficulty: Comprehension, DOK: 2 - Skill)

SWBAT complete the square to find the center and radius of a circle given by an equation. SWBAT graph circles in the coordinate plane.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.G-GPE.A.1	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Target 5.3.3 (Level of Difficulty: Knowledge Utilization, DOK: 3 - Strategic Thinking)

SWBAT derive the equation of a parabola given a focus and directrix.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.7	Look for and make use of structure.
MA.G-GPE.A.2	Derive the equation of a parabola given a focus and directrix.

21st Century Life and Careers

WORK.9-12.9.1.12.1	The ability to recognize a problem and apply critical thinking and problem-solving skills to solve the problem is a lifelong skill that develops over time.
WORK.9-12.9.1.12.1	Collaboration and teamwork enable individuals or groups to achieve common goals with greater efficiency.
WORK.9-12.9.1.12.2	Critical thinking and problem solving in the 21st century are enhanced by the ability to work in cross-cultural teams in face-to-face and virtual environments.
WORK.9-12.9.1.12.2	Leadership abilities develop over time through participation in groups and/or teams that are engaged in challenging or competitive activities.
WORK.9-12.9.1.12.A.1	Apply critical thinking and problem-solving strategies during structured learning experiences.
WORK.9-12.9.1.12.F.2	Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.
WORK.9-12.9.3.12.C.6	Develop job readiness skills by participating in structured learning experiences and employment seeking opportunities.

Summative Assessment

- Projects
- Quizzes
- Student Portfolios
- Tests

- Unit 1 Assessment (Common Assessment)

Formative Assessment and Performance Opportunities

- "I have...Who has..." Review Activities
- Academic Games
- Carousel Activities
- Class Discussions
- Classwork
- Closure Activities
- Concept Sorting Activities
- Do Nows
- Exit Tickets
- Four Corners Activities
- Graphic Organizers
- Homework
- Placemat Activities
- Question-All-Writes
- Quiz-Quiz-Trade Activities
- Station Activities
- Student Interviews
- Student Response Systems
- Student Self-Ratings
- Teacher Observation
- Teacher Questioning
- Think, Pair, Share Discussions
- Thumbs Up/Down
- Whip Around
- Whiteboard Use

Differentiation/Enrichment

- 504 Accommodations
- Challenge Problems
- IEP Modifications
- Learning Centers/Stations
- Leveled Practice Opportunities
- Scaffolding Questions
- Small Group Instruction

- Student Companion Website Resources
- Technology
- Use of Manipulatives (Paper Strips, Exploragons, etc.)

Unit Resources

- Textbook: Geometry, Common Core Ed. (Holt McDougal, 2012)
- Textbook Resource Kit & Companion Website: <https://my.hrw.com/>
- Geometer's Sketchpad
- Kuta Software

Additional Websites:

- Dan Meyer's 3-Act Math Tasks:
<https://docs.google.com/spreadsheets/pub?key=0AjIqyKM9d7ZYdEhtR3BJMmdBWnM2YWxWYVM1UWowTEE&output=htmlG>
- Engage NY: Geometry Lesson Notes & Handouts: <https://www.engageny.org/resource/high-school-geometry>
- Geometry Teacher Mike Patterson's Common Core Teaching Notes:
<http://www.geometrycommoncore.com/>
- Khan Academy: <https://www.khanacademy.org/>
- NCTM Illuminations Website: Resources for Teaching Math:
<http://illuminations.nctm.org/Default.aspx>
- PARCC Educator Resources: <http://www.parcconline.org/for-educators>
- The Geometer's Sketchpad Resource Center: <http://www.dynamicgeometry.com/>