UNIT 5

GEOMETRY

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REGION 1 ESA
UNIT 5
Geometry Unit 5 Overview: Circles With and Without Coordinates

In this unit, students prove basic theorems about circles, with particular attention to perpendicularity and inscribed angles, in order to see symmetry in circles and as an application of triangle congruence criteria. They study relationships among segments on chords, secants, and tangents as an application of similarity. In the Cartesian coordinate system, students use the distance formula to write the equation of a circle when given the radius and the coordinates of its center. Given an equation of a circle, they draw the graph in the coordinate plane, and apply techniques for solving quadratic equations to determine intersections between lines and circles or parabolas and between two circles.
# Unit 5: Circles With and Without Coordinates G.C.1

Cluster: Understand and apply theorems about circles.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Suggested Learning Targets and Type</th>
<th>Directly Aligned</th>
<th>Somewhat Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.C.1 Prove that all circles are similar.</td>
<td>• I can prove that all circles are similar by showing that for a dilation centered at the center of a circle, the pre-image and the image have equal central angle measures. (R)</td>
<td>Content/Skills Included in Textbook (Include page numbers and comments)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Enduring Understandings

The properties of polygons, lines, and angles can be used to understand circles; the properties of circles can be used to solve problems involving polygons, lines, and angles.

### Essential Questions

• How can the properties of circles, polygons, lines, and angles be useful when solving geometric problems?

### Assessment

Assessments align to suggested learning targets.

- Directly Aligned
- Somewhat Aligned
- Not Aligned

Check all assessment types that address this standard
- Drill and practice
- Multiple choice
- Short answer (written)
- Performance (verbal explanation)
- Product / Project

### Vocabulary

Circle, similar figures, rigid motion, dilation, angle measure, pre-image, image, central angle
### Unit 5: Circles With and Without Coordinates G.C.2

**Cluster:** Understand and apply theorems about circles.

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<tr>
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</table>
| **G.C.2** Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle. | - I can central angles, inscribed angles, circumscribed angles, diameters, radii, chords, and tangents. (K)  
- I can describe the relationship between a central angle and the arc it intercepts. (R)  
- I can describe the relationship between an inscribed angle and the arc it intercepts. (R)  
- I can describe the relationship between a circumscribed angle and the arc it intercepts. (R)  
- I can recognize that an inscribed angle whose sides intersect the endpoints of the diameter of a circle is a right angle. (K)  
- I can recognize that the radius of a circle is perpendicular to the tangent where the radius intersects the circle. (K) | Content/Skills Included in Textbook  
*Include page numbers and comments* |

**Instructional Notes:** none

**Enduring Understandings**

The properties of polygons, lines, and angles can be used to understand circles; the properties of circles can be used to solve problems involving polygons, lines, and angles.

<table>
<thead>
<tr>
<th>Essential Questions</th>
<th>Assessment</th>
</tr>
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<tbody>
<tr>
<td><strong>How can the properties of circles, polygons, lines, and angles be useful when solving geometric problems?</strong></td>
<td>Assessments align to suggested learning targets.</td>
</tr>
<tr>
<td></td>
<td>Directly Aligned</td>
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<tr>
<td></td>
<td>Check all assessment types that address this standard</td>
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<td></td>
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<td>- Multiple choice</td>
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<td></td>
<td>- Performance (verbal explanation)</td>
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<tr>
<td></td>
<td>- Product / Project</td>
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</table>

**Vocabulary**

Central angle, inscribed angle, circumscribed angle, diameter, radius, chord, tangent, circle, intersect, endpoints, right angle, perpendicular
### Unit 5: Circles With and Without Coordinates G.C.3

#### Cluster: Understand and apply theorems about circles.

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</tr>
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<tr>
<td>Instructional Notes: none</td>
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**G.C.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.**

- I can define the terms inscribed, circumscribed, angle bisector, and perpendicular bisector. (K)
- I can construct the inscribed circle whose center is the point of intersection of the angle bisectors (the incenter). (P)
- I can construct the circumscribed circle whose center is the point of intersection of the perpendicular bisectors of each side of the triangle (the circumcenter). (P)
- I can apply the Arc Addition Postulate to solve for missing arc measures. (S)
- I can prove that opposite angles in an inscribed quadrilateral are supplementary. (R)

#### Enduring Understandings

The properties of polygons, lines, and angles can be used to understand circles; the properties of circles can be used to solve problems involving polygons, lines, and angles.

**Essential Questions**

- **How can the properties of circles, polygons, lines, and angles be useful when solving geometric problems?**

**Assessment**

- Assessments align to suggested learning targets.

#### Vocabulary

- Inscribed, circumscribed, angle bisector, perpendicular bisector, construction, compass, straightedge, intersection, incenter, circle, circumcenter, quadrilateral, arc, inscribed angle, Arc Addition Postulate, equation, opposite angles, supplementary

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### Unit 5: Circles With and Without Coordinates  G.C.4

**Cluster:** Understand and apply theorems about circles.

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<th>Content/Skills Included in Textbook (Include page numbers and comments)</th>
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</table>
| G.C.4 (+) Construct a tangent line from a point outside a given circle to the circle. | • I can define and identify a tangent line. (K)  
• I can construct a tangent line from a point outside the circle to the circle using construction tools or computer software. (P) |                   |                  |             |                                                                           |

**Instructional Notes:** none

**Content/Skills Included in Textbook**

**Enduring Understandings**

The properties of polygons, lines, and angles can be used to understand circles; the properties of circles can be used to solve problems involving polygons, lines, and angles.

**Essential Questions**

• How can the properties of circles, polygons, lines, and angles be useful when solving geometric problems?

**Assessment**

Assessments align to suggested learning targets.  
- Check all assessment types that address this standard  
  - Drill and practice  
  - Multiple choice  
  - Short answer (written)  
  - Performance (verbal explanation)  
  - Product / Project

**Vocabulary**

Tangent line, circle perpendicular, radius, endpoint, midpoint, line segment, point
### Unit 5: Circles With and Without Coordinates G.C.5

**Cluster:** Find arc lengths and areas of sectors of circles.

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| **G.C.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. | • I can define similarity as rigid motions with dilations, which preserves angle measures and makes lengths proportional. (K)  
• I can use similarity to calculate the length of an arc. (S)  
• I can define the radian measure of an angle as the ratio of an arc length to its radius and calculate a radian measure when given an arc length and its radius. (R) | Content/Skills Included in Textbook (Include page numbers and comments) |

**Instructional Notes:** Emphasize the similarity of all circles. Note that by similarity of sectors with the same central angle, arc lengths are proportional to the radius. Use this as a basis for introducing radian as a unit of measure. It is not intended that it be applied to the development of circular trigonometry in this course.

**Enduring Understandings**

- The properties of polygons, lines, and angles can be used to understand circles; the properties of circles can be used to solve problems involving polygons, lines, and angles.

**Essential Questions**

- How can the properties of circles, polygons, lines, and angles be useful when solving geometric problems?

**Assessment**

- Assessments align to suggested learning targets.

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<tr>
<td>Performance (verbal explanation)</td>
<td>Product / Project</td>
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</table>

**Vocabulary**

- Similarity, rigid motion, dilation, angle measure, length, proportional, arc, constant of proportionality, radian, angle, area, circle sector, formula, intercepted arc
## Unit 5: Circles With and Without Coordinates G.C.5

### Cluster: Find arc lengths and areas of sectors of circles.

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<tr>
<td><strong>Instructional Notes:</strong> Emphasize the similarity of all circles. Note that by similarity of sectors with the same central angle, arc lengths are proportional to the radius. Use this as a basis for introducing radian as a unit of measure. It is not intended that it be applied to the development of circular trigonometry in this course.</td>
<td>• I can convert degrees to radians using the constant of proportionality ( \frac{2\pi \times \text{angle measure}}{360^\circ} ). (K) • I can calculate the area of a circle. (S) • I can define a sector of a circle. (K) • I can calculate the area of a sector using the ratio of the intercepted arc and ( 360^\circ ) multiplied by the area of the circle. (R)</td>
<td>Content/Skills Included in Textbook (Include page numbers and comments)</td>
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</table>

**G.C.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.

### Enduring Understandings

The properties of polygons, lines, and angles can be used to understand circles; the properties of circles can be used to solve problems involving polygons, lines, and angles.

### Essential Questions

• How can the properties of circles, polygons, lines, and angles be useful when solving geometric problems?

### Assessment

Assessments align to suggested learning targets.

- Check all assessment types that address this standard
  - Drill and practice
  - Multiple choice
  - Short answer (written)
  - Performance (verbal explanation)
  - Product / Project

### Vocabulary

Similarity, rigid motion, dilation, angle measure, length, proportional, arc, constant of proportionality, radian, angle, area, circle sector, formula, intercepted arc
### Unit 5: Circles With and Without Coordinates G.GPE.1

**Cluster:** Translate between the geometric description and the equation for a conic section.

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<tr>
<td><strong>Instructional Notes:</strong> none</td>
<td></td>
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</table>
| **G.GPE.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. | • I can identify the center and radius of a circle given its equation. (K)  
• I can draw a right triangle with a horizontal leg, a vertical leg, and the radius of a circle as its hypotenuse. (K)  
• I can use the distance formula (Pythagorean Theorem), the coordinates of a circle’s center, and the circle’s radius to write the equation of a circle. (R)  
• I can convert an equation of a circle in general (quadratic) form to standard form by completing the square. (S)  
• I can identify the center and radius of a circle given its equation. (R) | Content/Skills Included in Textbook (Include page numbers and comments) |

### Enduring Understandings

- Algebra can be used to efficiently and effectively describe and apply geometric properties.

### Essential Questions

- How can algebra be useful when expressing geometric properties?

### Assessments align to suggested learning targets.

- Check all assessment types that address this standard
  - Drill and practice
  - Multiple choice
  - Short answer (written)
  - Performance (verbal explanation)
  - Product / Project

### Vocabulary

- Distance formula, Pythagorean Theorem, difference, coordinates, radius, circle, hypotenuse, equation, center, complete the square, quadratic equation, conic equation, standard form, general form
### Unit 5: Circles With and Without Coordinates G.GPE.4

#### Cluster: Use coordinates to prove simple geometric theorems algebraically.

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</table>
| **Instructional Notes:** Include simple proofs involving circles. | - I can represent the vertices of a figure in the coordinate plane using variables. (R)  
- I can connect a property of a figure to the tool needed to verify that property. (R)  
- I can use coordinates and the right tool to prove or disprove a claim about a figure.  
  For example:  
  - Use slope to determine if sides are parallel, intersecting, or perpendicular;  
  - Use the distance formula to determine if sides are congruent or to decide if a point is inside the circle, outside the circle, or on the circle;  
  - Use the midpoint formula or the distance formula to decide if a side has been bisected. (R) | | | |

#### Enduring Understandings

- Algebra can be used to efficiently and effectively describe and apply geometric properties.

#### Essential Questions

- **How can algebra be useful when expressing geometric properties?**

#### Assessment

- Check all assessment types that address this standard
  - Drill and practice
  - Multiple choice
  - Short answer (written)
  - Performance (verbal explanation)
  - Product / Project

#### Vocabulary

- Side length, vertex, first quadrant, slope, distance, midpoint, parallel, perpendicular, intersecting
## Unit 5: Circles With and Without Coordinates G.MG.1

### Cluster: Apply geometric concepts in modeling situations.

### Standard

- G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*

### Suggested Learning Targets and Type

<table>
<thead>
<tr>
<th>Instructional Notes: Focus on situations in which the analysis of circles is required.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• I can represent real-world objects as geometric figures. (R)</td>
</tr>
<tr>
<td>• I can estimate measures (circumference, area, perimeter, volume) of real-world objects using comparable geometric shapes or three-dimensional figures. (R)</td>
</tr>
<tr>
<td>• I can apply the properties of geometric figures to comparable real-world objects (e.g., The spokes of a wheel of a bicycle are equal lengths because the represent the radii of a circle. (R)</td>
</tr>
</tbody>
</table>

### Content/Skills Included in Textbook

(Include page numbers and comments)

### Enduring Understandings

- Geometric definitions, properties, and theorems allow one to describe, model, and analyze situations in the real-world.

### Essential Questions

- In what ways can geometric figures be used to understand real-world situations?

### Assessment

- Assessments align to suggested learning targets.

### Vocabulary

- Circumference, area, perimeter, volume