Geometry
ECCHS

Geometry

Units of Study			
Unit 1:	Foundations of Geometry	14-15 days	1st semester
Unit 2:	Reasoning and Proof	13-15 days	1st semester
Unit 3:	Parallel and Perpendicular Lines	9-11 days	1st semester
Unit 4:	Transformations and Sequences	9-10 days	1st semester
Unit 5:	Congruence	7-9 days	1st semester
Unit 6:	Relationships within Triangles	15-17 days	2nd semester
Unit 7:	Similarity	7-9 days	2nd semester
Unit 8:	Right Triangle Trigonometry	14-15 days	2nd semester
Unit 9:	Polygons and Quadrilaterals	13-15 days	2nd semester
Unit 10:	Measurement and Volume	18-20 days	2nd semester
Unit 11:	Circles	19-21 days	2nd semester

Appendices

Appendix A: Proficiency Scale Template

Appendix B: PLC Form

Standards Breakdown

Green: Priority Standards **Pink:** Supporting Standards

STANDARDS		UNITS 1	2	3	4	5	6	7	8	9	10	11
Logic and Proofs	1	Pink	Pink	Pink			Pink					
	2	Pink	Pink	Pink								
	3		Pink									
	4		Green	Pink		Pink	Pink	Pink				
Points, Lines, Angles and Planes	1			Green			Green					
	2			Green								
	3	Pink		Pink			Pink					
	4	Pink							Pink	Pink		
Trans forma tions	1				Green							
	2				Pink							
Quadrilaterals and Other Polygons	1									Pink		
	2									Green		
	3									Pink		
	4				Pink							
	5										Pink	
	6										Pink	
Triangles	1					Pink	Green	Pink				
	2					Pink						
	3					Pink						
	4							Pink				
	5					Green		Green				
	6						Pink					
	7								Pink			
	8								Pink			
	9								Green			
	10								Green			
Three-dimensional solids	1										Pink	
	2										Pink	
	3										Pink	
	4										Green	
	5										Pink	
Circles	1											Pink
	2											Green
	3											Pink
	4											Pink
	5											Pink
	6											Pink

General Description of the Unit

In Unit 1, students will name and sketch geometric figures, use postulates to identify congruent segments, find lengths of segments in the coordinate plane using absolute value, Segment Addition, and the Distance Formula, and find the midpoint of a segment. Students will name, measure and classify angles, identify complementary and supplementary angles, and classify polygons. They will find the circumference and area of circles, and the area and perimeter of rectangles, squares, and triangles. Students will use tools to explain and justify the process to construct congruent segments and angles, angle bisectors, and perpendicular bisectors.

Priority Standards

Because this unit is foundational, there are no priority standards.

Supporting Standards

- **G.LP.1:** Understand and describe the structure of and relationships within an axiomatic system (undefined terms, definitions, axioms and postulates, methods of reasoning, and theorems). Understand the differences among supporting evidence, counterexamples, and actual proofs.
- **G.LP.2:** Use precise definitions for angle, circle, perpendicular lines, parallel lines, and line segment, based on the undefined notions of point, line, and plane. Use standard geometric notation.
- **G.PL.3:** Use tools to explain and justify the process to construct congruent segments and angles, angle bisectors, perpendicular bisectors, altitudes, medians, and parallel and perpendicular lines.
- **G.PL.4:** Develop the distance formula using the Pythagorean Theorem. Find the lengths and midpoints of line segments in the two-dimensional coordinate system.

Enduring Understandings

- It is important to be able to name and represent points, lines, and planes to communicate with and understand others. These terms are the foundation of geometry.
- A geometric construction can show the logic used to prove a specific theorem.
- The distance between two points on a coordinate plane can be found using the Pythagorean Theorem. This method can be generalized to develop the distance formula.

Essential Questions

- What symbols, formulas and vocabulary are conventional for communicating within the context of geometry?
- Why is it important to understand geometric constructions?
- Why might a delivery company use the distance formula?

Key Concepts

Related Concepts

- I can describe the structure of an axiomatic system and the relationships within. (G.LP.1)
- I can understand the difference among supporting evidence, counterexamples, and actual proofs. (G.LP.1)
- I can identify and name defined terms and undefined terms. (G.LP.1)
- I can apply definitions, postulates, and theorems to justify and support conclusions. (G.LP.1)
- I can precisely define angle using words, diagrams, and notation. (G.LP.2)

Vocabulary

- Altitude
- Angle
- Angle bisector
- Axiom
- Axiomatic system
- Circle
- Congruence
- Congruent angle
- Congruent segment
- Counterexample
- Distance formula
- Geometric notation
- Line
- Line Segment
- Median
- Midpoint
- Parallel Line

	• I can precisely define circle using words, diagrams, and notation. (G.LP.2) • I can precisely define line segment using words, diagrams, and notation. (G.LP.2) • I can precisely define parallel and perpendicular lines using words, diagrams, and notation. (G.LP.2) • I can explain what the undefined terms are and why they are undefined. (G.LP.2) • I can state the meaning of symbols and use them consistently and appropriately. (G.LP.2) • I can select an appropriate tool when asked to explain and justify geometric constructions. (G.PL.3) • I can explain and justify how to construct congruent segments. (G.PL.3) • I can explain and justify how to construct congruent angles. (G.PL.3) • I can explain and justify how to construct angle bisectors (G.PL.3) • I can explain and justify how to construct perpendicular bisectors. (G.PL.3) • I can explain and justify how to construct altitudes and medians. (G.PL.3) • I can explain and justify how to construct parallel and perpendicular lines (G.PL.3) • I can develop the distance formula from what I know about the Pythagorean Theorem. (G.PL.4) • I can find the midpoint of a line segment in the coordinate plane. (G.PL.4) • I can find the lengths of line segments in the coordinate plane. (G.PL.4) • I can find the midpoint and length of line segments given the endpoints of the segment. (G.PL.4)	• Parallel lines • Perpendicular bisector • Perpendicular Line • Perpendicular lines • Plane • Point • Postulate • Pythagorean Theorem • Theorem • Undefined term

Mathematical Processes

- PS.1: Make sense of problems and persevere in solving them.
- PS.3: Construct convincing arguments and critique the reasoning of others.

Resources		
Proficiency Scales	**Digital** • IDOE Examples/Tasks G.LP.1 • IDOE Examples/Tasks G.LP.2 • IDOE Examples/Tasks G.PL.3 • IDOE Examples/Tasks G.PL.4	**Manipulatives** • Compass • Coordinate Grid • Desmos Geometry • Protractor • Scientific Calculator • Straightedge • Two-Column Proof • Virtual Coordinate Plane

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In Unit 2, students will use inductive reasoning to make and test conjectures. They will analyze conditional statements and write the converse, inverse, and contrapositive. Students will use deductive reasoning and the laws of logic to develop simple logical arguments. They will use properties of equality and deductive reasoning to prove theorems about congruence, supplementary angles, complementary angles, and vertical angles.

Priority Standards

- **G.LP.4:** Understand that proof is the means used to demonstrate whether a statement is true or false mathematically. Develop geometric proofs, including those involving coordinate geometry, using two-column, paragraph, and flow chart formats.

Supporting Standards

- **G.LP.1:** Understand and describe the structure of and relationships within an axiomatic system (undefined terms, definitions, axioms and postulates, methods of reasoning, and theorems). Understand the differences among supporting evidence, counterexamples, and actual proofs.
- **G.LP.2:** Use precise definitions for angle, circle, perpendicular lines, parallel lines, and line segment, based on the undefined notions of point, line, and plane. Use standard geometric notation.
- **G.LP.3:** State, use, and examine the validity of the converse, inverse, and contrapositive of conditional ("if – then") and bi-conditional ("if and only if") statements.

Enduring Understandings

- Practicing geometric proofs strengthens deductive reasoning skills and heightens understanding of given theorems and postulates.
- Explaining the process helps the learner understand what has been done, whether the process was appropriate, and if the solution is reasonable in terms of the context.
- Properties, postulates, and theorems can be used to support logic when using deductive reasoning.

Essential Questions

- Why do we prove statements that have already been previously proven?
- Why are properties, postulates, and theorems important in mathematics?
- When is it important to carefully construct the language we use and deeply analyze what we're hearing? When is it not as important to be so technical?

Key Concepts

- I can explain the rationale for using proof in mathematics. (G.LP.4)
- I can use coordinate geometry to develop geometric proofs . (G.LP.4)
- I can develop geometric proofs in a two column format. (G.LP.4)
- I can develop geometric proofs in a paragraph format. (G.LP.4)
- I can develop geometric proofs in a flow chart format. (G.LP.4)
- I can connect related two-column proofs, paragraph proofs, and flow proofs. (G.LP.4)

Related Concepts

- I can describe the structure of an axiomatic system and the relationships within. (G.LP.1)
- I can understand the difference among supporting evidence, counterexamples, and actual proofs. (G.LP.1)
- I can identify and name defined terms and undefined terms. (G.LP.1)
- I can apply definitions, postulates, and theorems to justify and support conclusions. (G.LP.1)
- I can precisely define angle using words, diagrams, and notation. (G.LP.2)
- I can precisely define circle using words, diagrams, and notation. (G.LP.2)
- I can precisely define line segment using words, diagrams, and notation. (G.LP.2)
- I can precisely define parallel and perpendicular lines using words, diagrams, and notation. (G.LP.2)

Vocabulary

- Angle
- Axiom
- Axiomatic system
- Biconditional statement
- Circle
- Conditional statement
- Contrapositive
- Converse
- Coordinate proof
- Counterexample
- Direct proof
- Flow chart proof
- Geometric notation
- Geometric proof
- Inverse
- Line
- Line Segment
- Paragraph proof
- Parallel Line
- Perpendicular Line
- Plane
- Point
- Postulate
- Theorem
- Two-column proof

	• I can explain what the undefined terms are and why they are undefined. (G.LP.2) • I can state the meaning of symbols and use them consistently and appropriately. (G.LP.2) • I can write the converse, inverse, and contrapositive of conditional and biconditional statements. (G.LP.3) • I can apply the converse, inverse, and contrapositive of conditional and biconditional statements. (G.LP.3) • I can determine the validity of converse, inverse, and contrapositive statements. (G.LP.3)	• Undefined term

Mathematical Processes

- PS.5: Use appropriate tools strategically.
- PS.6: Attend precision.

Resources

Proficiency Scales	Digital	Manipulatives
• G.LP.4	• IDOE Examples/Tasks G.LP.4 • IDOE Examples/Tasks G.LP.1 • IDOE Examples/Tasks G.LP.2 • IDOE Examples/Tasks G.LP.3	• Compass • Coordinate Grid • Desmos Geometry • Protractor • Scientific Calculator • Straightedge • Two-Column Proof • Virtual Coordinate Plane

School Resources

Textbook	Formative Assessments

General Description of the Unit

In Unit 3, students will classify angle pairs formed by two or more lines intersected by a transversal, study angle relationships when the lines are parallel, and use angle relationships to prove lines parallel. They will investigate slopes of lines and study the relationship between slopes of parallel and perpendicular lines. Students will use tools to explain and justify the process to construct a line parallel to a given line through a given point and a line perpendicular to a given line through a given point.

Priority Standards

- **G.PL.1:** Prove and apply theorems about lines and angles, including the following:
  - Vertical angles are congruent.
  - When a transversal crosses parallel lines, alternate interior angles are congruent, alternate exterior angles are congruent, and corresponding angles are congruent.
  - When a transversal crosses parallel lines, same side interior angles are supplementary.
  - Points on a perpendicular bisector of a line segment are exactly those equidistant from the endpoints of the segment.
- **G.PL.2:** Explore the relationships of the slopes of parallel and perpendicular lines. Determine if a pair of lines are parallel, perpendicular, or neither by comparing the slopes in coordinate graphs and equations.

Supporting Standards

- **G.LP.1:** Understand and describe the structure of and relationships within an axiomatic system (undefined terms, definitions, axioms and postulates, methods of reasoning, and theorems). Understand the differences among supporting evidence, counterexamples, and actual proofs.
- **G.LP.2:** Use precise definitions for angle, circle, perpendicular lines, parallel lines, and line segment, based on the undefined notions of point, line, and plane. Use standard geometric notation.
- **G.LP.4:** Understand that proof is the means used to demonstrate whether a statement is true or false mathematically. Develop geometric proofs, including those involving coordinate geometry, using two-column, paragraph, and flow chart formats.
- **G.PL.3:** Use tools to explain and justify the process to construct congruent segments and angles, angle bisectors, perpendicular bisectors, altitudes, medians, and parallel and perpendicular lines.

Enduring Understandings

- Many angle pairs (vertical, those cut by a transversal across parallel lines) have consistent relationships, such as congruent or supplementary.
- Parallel lines have the same slope, while perpendicular lines have opposite reciprocal slopes.

Essential Questions

- Why might an architect use the angle relationships formed by a transversal crossing parallel lines?
- How do properties of parallel and perpendicular lines help us understand the world around us?

Key Concepts

- I can prove that vertical angles are congruent and apply that fact to problems. (G.PL.1)
- I can prove and apply the angle relationships formed when two parallel lines are cut by a transversal. (G.PL.1)
- I can prove that all points on the perpendicular bisector of a segment are equidistant from the segment endpoints and apply that fact to problems. (G.PL.1)
- I can graph parallel lines and discover that their slopes are the same. (G.PL.2)
- I can graph perpendicular lines and discover their slopes are opposite reciprocals. (G.PL.2)
- I can justify why perpendicular lines may have the same y-intercept while parallel lines may not. (G.PL.2)

Related Concepts

- I can describe the structure of an axiomatic system and the relationships within. (G.LP.1)
- I can understand the difference among supporting evidence, counterexamples, and actual proofs. (G.LP.1)
- I can identify and name defined terms and undefined terms. (G.LP.1)
- I can apply definitions, postulates, and theorems to justify and support conclusions. (G.LP.1)
- I can precisely define angle using words, diagrams, and notation. (G.LP.2)
- I can precisely define circle using words, diagrams, and notation. (G.LP.2)
- I can precisely define line segment using words, diagrams, and notation. (G.LP.2)

Vocabulary

- Alternate Exterior Angles Theorem
- Alternate Interior Angles Theorem
- Altitude
- Angle
- Angle bisector
- Axiom
- Axiomatic system
- Circle
- Congruence
- Congruent angle
- Congruent segment
- Coordinate proof
- Corresponding Angles Postulate
- Counterexample
- Direct proof
- Flow chart proof
- Line
- Opposite
- Paragraph proof
- Parallel lines
- Perpendicular bisector
- Perpendicular Bisector Theorem

• I can determine whether two lines are parallel, perpendicular, or neither given the equation. (G.PL.2) • I can determine whether two lines are parallel, perpendicular, or neither given the graph. (G.PL.2)	• I can precisely define parallel and perpendicular lines using words, diagrams, and notation. (G.LP.2) • I can explain what the undefined terms are and why they are undefined. (G.LP.2) • I can state the meaning of symbols and use them consistently and appropriately. (G.LP.2) • I can explain the rationale for using proof in mathematics. (G.LP.4) • I can use coordinate geometry to develop geometric proofs . (G.LP.4) • I can develop geometric proofs in a two column format. (G.LP.4) • I can develop geometric proofs in a paragraph format. (G.LP.4) • I can develop geometric proofs in a flow chart format. (G.LP.4) • I can connect related two-column proofs, paragraph proofs, and flow proofs. (G.LP.4) • I can select an appropriate tool when asked to explain and justify geometric constructions. (G.PL.3) • I can explain and justify how to construct congruent segments. (G.PL.3) • I can explain and justify how to construct congruent angles. (G.PL.3) • I can explain and justify how to construct angle bisectors (G.PL.3) • I can explain and justify how to construct perpendicular bisectors. (G.PL.3) • I can explain and justify how to construct altitudes and medians. (G.PL.3) • I can explain and justify how to construct parallel and perpendicular lines (G.PL.3)	• Perpendicular lines • Plane • Point • Postulate • Reciprocal • Same Side Interior Angles Theorem • Slope • Slope-intercept form • Theorem • Transversal • Two-column proof • Undefined term • Vertical Angle Congruence Theorem

Mathematical Processes

- PS.1: Make sense of problems and persevere in solving them.
- PS.7: Look for and make use of structure.

Resources

Proficiency Scales	Digital	Manipulatives
• G.PL.1 • G.PL.2	• IDOE Examples/Tasks G.PL.1 • IDOE Examples/Tasks G.PL.2 • IDOE Examples/Tasks G.LP.1 • IDOE Examples/Tasks G.LP.2 • IDOE Examples/Tasks G.LP.4 • IDOE Examples/Tasks G.PL.3	• Compass • Coordinate Grid • Desmos Geometry • Graphing Calculator • Paragraph Proof • Parallel and Perpendicular Lines (Geogebra) • Protractor • Scientific Calculator • Straightedge • Two-Column Proof • Virtual Coordinate Plane • Virtual Transversal Manipulative

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In Unit 4, students will perform translations, reflect figures over a given line, rotate figures about a point, and identify line and rotational symmetry. Students will perform dilations that are reductions or enlargements, and verify that a figure is similar to its dilation. Students will perform transformation sequences and identify coordinates and write rules for the sequence.

Priority Standards

- **G.TR.1:** Use geometric descriptions of rigid motions to transform figures and to predict and describe the results of translations, reflections and rotations on a given figure. Describe a motion or series of motions that will show two shapes are congruent.

Supporting Standards

- **G.QP.4:** Identify types of symmetry of polygons, including line, point, rotational, and self-congruences.
- **G.TR.2:** Verify experimentally the properties of dilations given by a center and a scale factor. Understand the dilation of a line segment is longer or shorter in the ratio given by the scale factor.

Enduring Understandings

- A rigid transformation only changes the location of a figure, so the original figure and the image are congruent. A non-rigid transformation (dilation) changes the size of a figure proportionally, so the original figure and the image are similar.
- Translation shifts a point (or points) horizontally and vertically. Rotation turns a point (or points) around a fixed center point. Reflection mirrors a point (or points) over a given line.
- Non-rigid transformations occur any time a figure's size is altered but remains proportional to its original shape.

Essential Questions

- What is an example of a rigid transformation in the real-world?
- How does polygon symmetry relate to transformations?
- How do non-rigid transformations occur in real-world problems?

Key Concepts

- I can show two figures are congruent if there is a sequence of rigid motions that map one figure to another. (G.TR.1)
- I can show two figures are congruent if and only if they have the same shape and size. (G.TR.1)
- I can use composite transformations to map one figure to another. (G.TR.1)
- I can recognize the effects of rigid motion on orientation and location of a figure. (G.TR.1)

Related Concepts

- I can identify line, point, and/or rotational symmetry in a variety of polygons. (G.QP.4)
- I can identify self-congruence in polygons. (G.QP.4)
- I can develop the properties of dilations given by a center and scale factor. (G.TR.2)
- I can perform dilations when the center of dilation is in, on, and out of a figure. (G.TR.2)
- I can dilate a figure when given the center of dilation and a scale factor. (G.TR.2)
- I can determine the center of dilation and the scale factor from a diagram. (G.TR.2)

Vocabulary

- Congruent
- Dilation
- Line symmetry
- Point symmetry
- Reflections
- Rigid Motion
- Rotational symmetry
- Rotations
- Scale factor
- Self-congruency
- Symmetry
- Transformations
- Translations

Mathematical Processes

- PS.2: Reason abstractly and quantitatively.
- PS.3 Construct convincing arguments and critique the reasoning of others.
- PS.4 Model with mathematics.
- PS.8: Look for and express regularity with repeated reasoning.

Resources		
Proficiency Scales • G.TR.1	**Digital** • IDOE Examples/Tasks G.TR.1 • IDOE Examples/Tasks G.QP.4 • IDOE Examples/Tasks G.TR.2	**Manipulatives** • Compass • Coordinate Grid • Desmos Geometry • Protractor • Scientific Calculator • Straightedge

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will identify congruent figures and use tools to explain and justify the process to construct congruent triangles. They will identify congruent parts of congruent triangles after proving triangles congruent. Students will also use congruence to prove additional theorems, such as the Isosceles Triangle Theorem and its converse.

Priority Standards

- **G.T.5:** Use congruent and similar triangles to solve real-world and mathematical problems involving sides, perimeters, and areas of triangles.

Supporting Standards

- **G.LP.4:** Understand that proof is the means used to demonstrate whether a statement is true or false mathematically. Develop geometric proofs, including those involving coordinate geometry, using two-column, paragraph, and flow chart formats.
- **G.T.1:** Prove and apply theorems about triangles, including the following:
  - Measures of interior angles of a triangle sum to 180°.
  - The Isosceles Triangle Theorem and its converse.
  - The Pythagorean Theorem.
  - The segment joining midpoints of two sides of a
  - triangle is parallel to the third side and half the length.
  - A line parallel to one side of a triangle divides the other two proportionally, and its converse.
  - The Angle Bisector Theorem.
- **G.T.2:** Explore and explain how the criteria for triangle congruence (ASA, SAS, AAS, SSS, and HL) follow from the definition of congruence in terms of rigid motions.
- **G.T.3:** Use tools to explain and justify the process to construct congruent triangles.

Enduring Understandings

- Practicing geometric proofs strengthens deductive reasoning skills and heightens understanding of given theorems and postulates.
- Facts about congruent triangles are additional tools that can be used when analyzing a situation involving triangles.
- Two objects can be proven congruent using rigid transformations.
- There are 5 main theorems for proving triangle congruence. Other triangle theorems may be needed as accessories in the proof.

Essential Questions

- What key features in a diagram can help select a theorem to apply to a problem?
- What is an example of a rigid transformation in the real-world?
- How do I decide which theorem to use when proving two triangles are congruent?
- What are some real-world settings that might need to construct congruent triangles?

Key Concepts

- I can solve real-world problems using congruent triangles, including perimeter, area, and missing lengths. (G.T.5)
- I can solve real-world problems involving similar triangles, including perimeter, area, and missing lengths. (G.T.5)
- I can solve problems using CPCTC (corresponding part of congruent triangles are congruent). (G.T.5)

Related Concepts

- I can explain the rationale for using proof in mathematics. (G.LP.4)
- I can use coordinate geometry to develop geometric proofs . (G.LP.4)
- I can develop geometric proofs in a two column format. (G.LP.4)
- I can develop geometric proofs in a paragraph format. (G.LP.4)
- I can develop geometric proofs in a flow chart format. (G.LP.4)
- I can connect related two-column proofs, paragraph proofs, and flow proofs. (G.LP.4)

Vocabulary

- Angle-Angle
- Angle-Angle-Side triangle congruence
- Angle-Side-Angle triangle congruence
- Area of a triangle
- Base Angles Theorem
- Congruence
- Congruent triangles
- Coordinate proof
- CPCTC
- Direct proof

	• I can prove and apply that the sum of the interior angles of a triangle is 180°. (G.T.1) • I can prove and apply the Isosceles Triangle Theorem. (G.T.1) • I can prove and apply the converse of the Isosceles Triangle Theorem. (G.T.1) • I can prove and apply that the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length. (G.T.1) • I can prove the Pythagorean Theorem. (G.T.1) • I can identify corresponding angles and sides based on congruence statements. (G.T.2) • I can write congruence statements for two congruent triangles. (G.T.2) • I can determine if two triangles are congruent based on their corresponding parts. (G.T.2) • I can explain and apply the criteria of SSS, SAS, AAS, HL and ASA to prove triangle congruence. (G.T.2) • I can explain when it is appropriate to use HL. (G.T.2) • I can show cases in which AA and SSA do and do not prove triangle congruence. (G.T.2) • I can explain the connection between the criteria for triangle congruence and rigid motions. (G.T.2) • I can select an appropriate tool when asked to explain and justify geometric constructions. (G.T.3) • I can construct congruent triangles with a variety of geometric tools. (G.T.3) • I can explain and justify the process of my construction. (G.T.3)	• Flow chart proof • Geometric proof • Hypotenuse-Leg triangle congruence • Isosceles Triangle Theorem • Paragraph proof • Perimeter • Pythagorean Theorem • Rigid motion • Side-Angle-Side triangle congruence • Side-Side-Angle • Side-Side-Side triangle congruence • Two-column proof

Mathematical Processes

- PS.4 Model with mathematics.
- PS.6: Attend precision.

Resources		
Proficiency Scales • G.LP.4 • G.T.5 • G.TR.1	**Digital** • IDOE Examples/Tasks G.T.5 • IDOE Examples/Tasks G.LP.4 • IDOE Examples/Tasks G.T.1 • IDOE Examples/Tasks G.T.2 • IDOE Examples/Tasks G.T.3	**Manipulatives** • Compass • Desmos Geometry • Graphing Calculator • Paragraph Proof • Protractor • Scientific Calculator • Straightedge • Straws (Congruence Discovery) • Triangle Congruence Investigation • Two-Column Proof

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will classify triangles, find measures of angles of triangles, and use theorems about isosceles and equilateral triangles. They will use properties of midsegments to find lengths of segments in triangles and will learn to write a coordinate proof. Students will learn points of concurrency created by perpendicular bisectors, angle bisectors, medians, and altitudes in triangles and will apply their theorems to find segment lengths and angle measures. Students will relate side length and angle measures of a triangle, find possible side lengths for the third side of a triangle, use inequalities to make comparisons in two triangles, and use the Hinge Theorem and its converse to solve multi-step problems. Students will also learn to write indirect proofs.

Priority Standards

- **G.PL.1:** Prove and apply theorems about lines and angles, including the following:
  - Vertical angles are congruent.
  - When a transversal crosses parallel lines, alternate interior angles are congruent, alternate exterior angles are congruent, and corresponding angles are congruent.
  - When a transversal crosses parallel lines, same side interior angles are supplementary.
  - Points on a perpendicular bisector of a line segment are exactly those equidistant from the endpoints of the segment.
- **G.T.1:** Prove and apply theorems about triangles, including the following:
  - Measures of interior angles of a triangle sum to 180°.
  - The Isosceles Triangle Theorem and its converse.
  - The Pythagorean Theorem.
  - The segment joining midpoints of two sides of a triangle is parallel to the third side and half the length.
  - A line parallel to one side of a triangle divides the other two proportionally, and its converse.
  - The Angle Bisector Theorem.

Supporting Standards

- **G.LP.1:** Understand and describe the structure of and relationships within an axiomatic system (undefined terms, definitions, axioms and postulates, methods of reasoning, and theorems). Understand the differences among supporting evidence, counterexamples, and actual proofs.
- **G.LP.4:** Understand that proof is the means used to demonstrate whether a statement is true or false mathematically. Develop geometric proofs, including those involving coordinate geometry, using two-column, paragraph, and flow chart formats.
- **G.PL.3:** Use tools to explain and justify the process to construct congruent segments and angles, angle bisectors, perpendicular bisectors, altitudes, medians, and parallel and perpendicular lines.
- **G.T.6:** Prove and apply the inequality theorems, including the following:
  - Triangle inequality.
  - Inequality in one triangle.
  - The hinge theorem and its converse.

Enduring Understandings

- To begin an indirect proof, assume temporarily the inverse of what is to be proven. Proceed with the proof until a contradiction arrives. Then our assumption is false and what we are trying to prove is true.
- A point of concurrency is created when three lines intersect. Depending on the concurrent lines, a relationship is then created amongst lengths and angle measures involving the triangle.

Essential Questions

- How do I write an indirect proof?
- What happens when three lines intersect within a triangle?

Key Concepts

- I can prove that vertical angles are congruent and apply that fact to problems. (G.PL.1)
- I can prove and apply the angle relationships formed when two parallel lines are cut by a transversal. (G.PL.1)
- I can prove that all points on the perpendicular bisector of a segment are equidistant from the segment

Related Concepts

- I can describe the structure of an axiomatic system and the relationships within. (G.LP.1)
- I can understand the difference among supporting evidence, counterexamples, and actual proofs. (G.LP.1)
- I can identify and name defined terms and undefined terms. (G.LP.1)

Vocabulary

- Alternate Exterior Angles Theorem
- Alternate Interior Angles Theorem
- Altitude
- Angle bisector
- Axiom
- Axiomatic system
- Base Angles Theorem
- Congruence
- Coordinate proof
- Corresponding Angles Postulate

endpoints and apply that fact to problems. (G.PL.1) • I can prove and apply that the sum of the interior angles of a triangle is 180°. (G.T.1) • I can prove and apply the Isosceles Triangle Theorem. (G.T.1) • I can prove and apply the converse of the Isosceles Triangle Theorem. (G.T.1) • I can prove and apply that the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length. (G.T.1) • I can prove the Pythagorean Theorem. (G.T.1)	• I can apply definitions, postulates, and theorems to justify and support conclusions. (G.LP.1) • I can explain the rationale for using proof in mathematics. (G.LP.4) • I can use coordinate geometry to develop geometric proofs . (G.LP.4) • I can develop geometric proofs in a two column format. (G.LP.4) • I can develop geometric proofs in a paragraph format. (G.LP.4) • I can develop geometric proofs in a flow chart format. (G.LP.4) • I can connect related two-column proofs, paragraph proofs, and flow proofs. (G.LP.4) • I can select an appropriate tool when asked to explain and justify geometric constructions. (G.PL.3) • I can explain and justify how to construct congruent segments. (G.PL.3) • I can explain and justify how to construct congruent angles. (G.PL.3) • I can explain and justify how to construct angle bisectors (G.PL.3) • I can explain and justify how to construct perpendicular bisectors. (G.PL.3) • I can explain and justify how to construct altitudes and medians. (G.PL.3) • I can explain and justify how to construct parallel and perpendicular lines (G.PL.3) • I can prove and apply the triangle inequality theorem. (G.T.6) • I can prove and apply the greater angle and greater side theorem. (G.T.6) • I can prove and apply the Hinge Theorem and its converse. (G.T.6)	• Counterexample • Direct proof • Flow chart proof • Geometric proof • Hinge Theorem • Median • Midsegment Theorem • Paragraph proof • Parallel lines • Perpendicular bisector • Perpendicular Bisector Theorem • Perpendicular lines • Postulate • Pythagorean Theorem • Same Side Interior Angles Theorem • Theorem • Transversal • Triangle Inequality Theorem • Triangle Proportionality Theorem • Triangle Sum Theorem • Two-column proof • Undefined terms • Vertical Angle Congruence Theorem

Mathematical Processes

- PS.6: Attend precision.
- PS.7: Look for and make use of structure.

Resources		
Proficiency Scales • G.PL.1 • G.T.1	**Digital** • IDOE Examples/Tasks G.PL.1 • IDOE Examples/Tasks G.T.1 • IDOE Examples/Tasks G.LP.1 • IDOE Examples/Tasks G.LP.4 • IDOE Examples/Tasks G.PL.3 • IDOE Examples/Tasks G.T.6	**Manipulatives** • Compass • Coordinate Grid • Desmos Geometry • Geogebra Angle Bisector Construction • Graphing Calculator • Paragraph Proof • Protractor • Scientific Calculator • Straightedge • Straightedge • Two-Column Proof • Two-Column Proof (can be laminated for reuse by students)

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

Students will use ratios and proportions to solve geometry and real-world problems. Then they will use proportions to identify similar polygons and use the scale factor to find corresponding lengths in similar polygons, as well as the Triangle Proportionality Theorem and its converse to find the lengths of segments related to triangles or parallel lines. Students will use various Theorems and Postulates to prove triangles similar and congruent.

Priority Standards

- **G.T.5:** Use congruent and similar triangles to solve real-world and mathematical problems involving sides, perimeters, and areas of triangles.

Supporting Standards

- **G.LP.4:** Understand that proof is the means used to demonstrate whether a statement is true or false mathematically. Develop geometric proofs, including those involving coordinate geometry, using two-column, paragraph, and flow chart formats.
- **G.T.1:** Prove and apply theorems about triangles, including the following:
  - Measures of interior angles of a triangle sum to 180°.
  - The Isosceles Triangle Theorem and its converse.
  - The Pythagorean Theorem.
  - The segment joining midpoints of two sides of a triangle is parallel to the third side and half the length.
  - A line parallel to one side of a triangle divides the other two proportionally, and its converse.
  - The Angle Bisector Theorem.
- **G.T.4:** Use the definition of similarity in terms of similarity transformations, to determine if two given triangles are similar. Explore and develop the meaning of similarity for triangles.

Enduring Understandings

- Practicing geometric proofs strengthens deductive reasoning skills and heightens understanding of given theorems and postulates.
- Facts about similar triangles are additional tools that can be used when analyzing a situation involving triangles.
- Similar triangles are the same shape but may be different sizes.
- A rigid transformation only changes the location of a figure, so the original figure and the image are congruent. A non-rigid transformation (dilation) changes the size of a figure proportionally, so the original figure and the image are similar.

Essential Questions

- What key features in a diagram can help select a theorem to apply to a problem?
- How are the properties of similar triangles and congruent triangles different? How are they alike?
- How do non-rigid transformations occur in real-world problems?

Key Concepts

- I can solve real-world problems using congruent triangles, including perimeter, area, and missing lengths. (G.T.5)
- I can solve real-world problems involving similar triangles, including perimeter, area, and missing lengths. (G.T.5)
- I can solve problems using CPCTC (corresponding part of congruent triangles are congruent). (G.T.5)

Related Concepts

- I can explain the rationale for using proof in mathematics. (G.LP.4)
- I can use coordinate geometry to develop geometric proofs . (G.LP.4)
- I can develop geometric proofs in a two column format. (G.LP.4)
- I can develop geometric proofs in a paragraph format. (G.LP.4)
- I can develop geometric proofs in a flow chart format. (G.LP.4)

Vocabulary

- Angle-Angle triangle similarity
- Area of a triangle
- Base Angles Theorem
- Coordinate proof
- Corresponding parts
- Direct proof
- Flow chart proof
- Geometric proof
- Midsegment Theorem
- Paragraph proof
- Perimeter

	• I can connect related two-column proofs, paragraph proofs, and flow proofs. (G.LP.4) • I can prove and apply that the sum of the interior angles of a triangle is 180°. (G.T.1) • I can prove and apply the Isosceles Triangle Theorem. (G.T.1) • I can prove and apply the converse of the Isosceles Triangle Theorem. (G.T.1) • I can prove and apply that the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length. (G.T.1) • I can prove the Pythagorean Theorem. (G.T.1) • I can identify corresponding angles and sides based on similarity statements. (G.T.4) • I can develop and write similarity statements for two triangles. (G.T.4) • I can determine if two triangles are similar based on their corresponding parts. (G.T.4) • I can prove two triangles to be similar using the minimum requirements of AA. (G.T.4)	• Proportional • Pythagorean Theorem • Similar triangles • Similarity • Similarity transformation • Triangle Proportionality Theorem • Triangle Sum Theorem • Two-column proof

Mathematical Processes

- PS.4 Model with mathematics.
- PS.7: Look for and make use of structure.

Resources

Proficiency Scales	Digital	Manipulatives
• G.T.5	• IDOE Examples/Tasks G.T.5 • IDOE Examples/Tasks G.LP.4 • IDOE Examples/Tasks G.T.1 • IDOE Examples/Tasks G.T.4	• Compass • Coordinate Grid • Desmos Geometry • Geogebra: Similar Triangles • Protractor • Scientific Calculator • **Straightedge** • Two-Column Proof • Virtual Coordinate Plane

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will investigate side lengths and angles in right triangles. They start by using the Pythagorean Theorem to find a side length on a right triangle, then use the Converse of the Pythagorean Theorem and other theorems, to decide if three given side lengths form an acute, right, or obtuse triangle. Students will explore ratios of lengths formed by an altitude to the hypotenuse of a right triangle and use the ratios of side lengths for a 45-45-90 triangle and a 30-60-90 triangle to solve real-world and other mathematical problems. Students will apply trigonometric ratios to find side lengths and angle measures in triangles.

Priority Standards

- **G.T.10:** Explore the relationship between the sides of special right triangles (30° - 60° and 45° - 45°) and use them to solve real-world and other mathematical problems.
- **G.T.9:** Use trigonometric ratios (sine, cosine, tangent and their inverses) and the Pythagorean Theorem to solve real-world and mathematical problems involving right triangles.

Supporting Standards

- **G.PL.4:** Develop the distance formula using the Pythagorean Theorem. Find the lengths and midpoints of line segments in the two-dimensional coordinate system.
- **G.T.7:** Explore the relationships that exist when the altitude is drawn to the hypotenuse of a right triangle. Understand and use the geometric mean to solve for missing parts of triangles.
- **G.T.8:** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

Enduring Understandings

- The ratio of corresponding sides in a pair of similar triangles will always be the same. Thus, trigonometric ratios in similar right triangles will remain the same no matter the scale factor.
- Trigonometry can be used in a broad variety of ways that involve measures with triangles. For example, calculating the angle of elevation or angle of depression of an airplane, the algorithm a computer might use to detect sound waves in music, to measure the height of a structure, and much more.

Essential Questions

- How do I know when a result is reasonable?
- How does similarity relate to trigonometric ratios?
- How can trigonometry be applied to real world situations?

Key Concepts

- I can collect data to identify patterns when exploring the relationships between sides of 45°-45°-90° triangles. (G.T.10)
- I can collect data to identify patterns when exploring the relationships between sides of 30°-60°-90° triangles. (G.T.10)
- I can use special right triangles to solve mathematical problems. (G.T.10)
- I can use special right triangles to solve real-world problems. (G.T.10)
- I can determine the most appropriate trigonometric ratio (sine, cosine, tangent) to use for a given problem based on the information provided. (G.T.9)
- I can solve for sides and angles of right triangles using trigonometry. (G.T.9)
- I can interpret verbal descriptions into lengths and angles of a right

Related Concepts

- I can develop the distance formula from what I know about the Pythagorean Theorem. (G.PL.4)
- I can find the midpoint of a line segment in the coordinate plane. (G.PL.4)
- I can find the lengths of line segments in the coordinate plane. (G.PL.4)
- I can find the midpoint and length of line segments given the endpoints of the segment. (G.PL.4)
- I can explore the relationships that exist when the altitude is drawn to the hypotenuse of a right triangle. (G.T.7)
- I can define the geometric mean as a way of finding a value between widely different values. (G.T.7)
- I can find the geometric mean between two numbers. (G.T.7)

Vocabulary

- 30°-60°-90° triangle
- 45°-45°-90° triangle
- Acute angles
- Altitude
- Arithmetic mean
- Cosine
- Distance formula
- Geometric mean
- Hypotenuse
- Midpoint
- Pythagorean Theorem
- Ratio
- Reference angle
- Right triangle
- Similarity
- Sine
- Special right triangles
- Square root
- Tangent
- Trigonometric ratios

triangle to diagram a relationship. (G.T.9) • I can identify whether the Pythagorean Theorem or trigonometry is necessary to solve a problem involving missing lengths of right triangles. (G.T.9)	• I can use the geometric mean to solve for sides of triangles. (G.T.7) • I can label a triangle in relation to the reference angle (opposite, adjacent, hypotenuse). (G.T.8) • I can write the basic trigonometric ratios given three side lengths, or given two side lengths. (G.T.8) • I can collect data to identify patterns when forming ratios that lead to the definition of the Trigonometric ratios. (G.T.8)	

Mathematical Processes

- PS.3 Construct convincing arguments and critique the reasoning of others.
- PS.8: Look for and express regularity with repeated reasoning.

Resources

Proficiency Scales	Digital	Manipulatives
• G.T.9 • G.T.10	• IDOE Examples/Tasks G.T.10 • IDOE Examples/Tasks G.T.9 • IDOE Examples/Tasks G.PL.4 • IDOE Examples/Tasks G.T.7 • IDOE Examples/Tasks G.T.8	• Compass • Desmos Geometry • Introduction to Trig Ratios • Isosceles Right Triangle: Quick Investigation • Protractor • Scientific Calculator • **Straightedge**

School Resources

Textbook	Formative Assessments

General Description of the Unit

In this unit students will develop and use formulas to find measures of interior and exterior angles of polygons. They will investigate properties of parallelograms and determine what information can be used to prove a quadrilateral is a parallelogram. Students will also explore the properties of special quadrilaterals such as rhombuses, rectangles, squares, trapezoids, and kites and create coordinate proofs of quadrilaterals.

Priority Standards

- **G.QP.2:** Prove that given quadrilaterals are parallelograms, rhombuses, rectangles, squares, kites, or trapezoids. Include coordinate proofs of quadrilaterals in the coordinate plane.

Supporting Standards

- **G.PL.4:** Develop the distance formula using the Pythagorean Theorem. Find the lengths and midpoints of line segments in the two-dimensional coordinate system.
- **G.QP.1:** Prove and apply theorems about parallelograms, including those involving angles, diagonals, and sides.
- **G.QP.3:** Develop and use formulas to find measures of interior and exterior angles of polygons.

Enduring Understandings

- Quadrilaterals are classified using specific relationships among the side lengths and angle measures.
- Properties of quadrilaterals can be verified using slope, the Distance Formula, and the Pythagorean Theorem to identify relationships among the side lengths and angle measures.

Essential Questions

- How can the properties of quadrilaterals be verified using the coordinate plane?
- What is real-world situation where the properties of a parallelogram would be helpful to know?
- Why does the sum of the interior angles of a polygon depend on the number of sides, yet the exterior angle sums remain constant?

Key Concepts

- I can prove properties of rectangles. (G.QP.2)
- I can prove the properties of rhombi. (G.QP.2)
- I can prove the properties of squares. (G.QP.2)
- I can prove the properties of kites. (G.QP.2)
- I can classify a quadrilateral by its properties. (G.QP.2)
- I can classify a quadrilateral through the use of coordinate proof. (G.QP.2)

Related Concepts

- I can develop the distance formula from what I know about the Pythagorean Theorem. (G.PL.4)
- I can find the midpoint of a line segment in the coordinate plane. (G.PL.4)
- I can find the lengths of line segments in the coordinate plane. (G.PL.4)
- I can find the midpoint and length of line segments given the endpoints of the segment. (G.PL.4)
- I can prove properties of parallelograms then apply them. (G.QP.1)
- I can prove that opposite sides are congruent in parallelograms and apply my understanding. (G.QP.1)
- I can prove that opposite angles are congruent in parallelograms and apply my understanding. (G.QP.1)
- I can prove that the diagonals of a parallelogram bisect each other and apply my understanding. (G.QP.1)
- I can prove rectangles are parallelograms with congruent diagonals. (G.QP.1)
- I can conclude that the measures of the exterior angles of any polygon

Vocabulary

- Bisect
- Coordinate proof
- Diagonal
- Distance formula
- Exterior angle
- Interior angle
- Midpoint
- Parallelogram
- Polygon
- Pythagorean Theorem
- Quadrilaterals
- Rectangle
- Regular polygon
- Rhombus
- Square
- Theorems about parallelograms
- Trapezoid

	sum to 360° through exploration. (G.QP.3) • I can develop a strategy for finding the measure of a single exterior angle of a regular polygon. (G.QP.3) • I can find patterns and develop the formula for the sum of the measures of the interior angles of a polygon. (G.QP.3) • I can find the measure of a single angle in a regular polygon given the sum of the interior angles. (G.QP.3)	

Mathematical Processes

- PS.2: Reason abstractly and quantitatively.
- PS.8: Look for and express regularity with repeated reasoning.

Resources

Proficiency Scales	Digital	Manipulatives
• G.QP.2	• IDOE Examples/Tasks G.QP.2 • IDOE Examples/Tasks G.PL.4 • IDOE Examples/Tasks G.QP.1 • IDOE Examples/Tasks G.QP.3	• Compass • Coordinate Grid • Desmos Geometry • Geogebra: Exterior Angles of Polygons (Quadrilateral) • Geogebra: Quadrilaterals Exploration • Protractor • Scientific Calculator • Straightedge • Two-Column Proof • Virtual Coordinate Plane

School Resources

Textbook	Formative Assessments

General Description of the Unit

In this unit students will develop and use formulas for the area of triangles, parallelograms, trapezoids, and other polygons. Using their understanding of circles from unit nine, students will develop and use a formula for the area of a regular polygon. Students identify and name solids, and work with nets. They will explore symmetries of solids and properties of congruent and similar solids. Students will solve problems using the surface area and volume of prisms, cylinders, cones, pyramids, spheres, and composite solids.

Priority Standards

- **G.TS.4:** Solve real-world and other mathematical problems involving volume and surface area of prisms, cylinders, cones, spheres, and pyramids, including problems that involve composite solids and algebraic expressions.

Supporting Standards

- **G.QP.5:** Compute perimeters and areas of polygons in the coordinate plane to solve real-world and other mathematical problems.
- **G.QP.6:** Develop and use formulas for areas of regular polygons.
- **G.TS.1:** Create a net for a given three-dimensional solid. Describe the three-dimensional solid that can be made from a given net (or pattern).
- **G.TS.2:** Explore and use symmetries of three-dimensional solids to solve problems.
- **G.TS.3:** Explore properties of congruent and similar solids, including prisms, regular pyramids, cylinders, cones, and spheres and use them to solve problems.
- **G.TS.5:** Apply geometric methods to create and solve design problems.

Enduring Understandings

- The area of a regular polygon can be found by splitting the polygon into equal triangles and calculating the area of each triangle; the trigonometric ratios are often needed to find missing parts of the triangle.
- Like two-dimensional objects, three-dimensional objects can also have one or more symmetries and can be congruent or similar to one another.
- Geometric properties, such as volume or surface area, are often utilized when designing new packaging or other objects; maximizing volume or minimizing surface areas are sometimes the goals.

Essential Questions

- What is a home improvement project where volume and surface area calculations would be necessary?
- How does right triangle trigonometry help calculate the area of a regular polygon?
- Is it possible to have more than one net for a three-dimensional object? Why or why not?
- How might a manufacturing business use properties of three-dimensional objects when designing a new product?

Key Concepts

- I can calculate the volume of prisms, cylinders, pyramids, cones, and spheres. (G.TS.4)
- I can calculate the surface area of prisms, cylinders, pyramids, cones, and spheres. (G.TS.4)
- I can apply the formula for the volume of solids to solve real-world problems. (G.TS.4)
- I can apply the formula for surface area of solids to solve real-world problems. (G.TS.4)
- I can solve mathematical problems involving volume and surface area of solids that includes algebraic expressions. (G.TS.4)
- I can solve mathematical problems involving volume and surface area of composite solids. (G.TS.4)

Related Concepts

- I can find the measures of sides of a polygon on the coordinate plane. (G.QP.5)
- I can use the distance formula or Pythagorean theorem to compute the perimeter and/or area of polygons in the coordinate plane. (G.QP.5)
- I can solve real-world problems involving perimeter and area of polygons in the coordinate plane. (G.QP.5)
- I can show the area of a regular polygon is the sum of the areas of the triangles that make it up. (G.QP.6)
- I can develop the formula for finding the area of regular polygons and apply my understanding. (G.QP.6)

Vocabulary

- Algebraic expression
- Apothem
- Area
- Composite solid
- Cone
- Congruent solid
- Coordinate plane
- Cylinder
- Design
- Distance formula
- Net
- Perimeter
- Polygon
- Prism
- Pyramid
- Pythagorean Theorem
- Regular polygon
- Regular pyramid
- Similar solid
- Sphere

	• I can create nets for geometric solids. (G.TS.1) • I can describe the three-dimensional solid that can be made from a given net. (G.TS.1) • I can explore symmetries of three-dimensional solids. (G.TS.2) • I can solve problems involving symmetries of three-dimensional solids. (G.TS.2) • I can explore the properties of congruent solids, prisms, regular pyramids, cylinders, cones, and spheres. (G.TS.3) • I can explore the properties of similar solids, including prisms, regular pyramids, cylinders, cones, and spheres. (G.TS.3) • I can solve problems involving congruent and similar solids. (G.TS.3) • I can apply various geometric methods to create design problems (G.TS.5) • I can apply various geometric methods to solve design problems (G.TS.5)	• Surface area • Three-dimensional solid • Volume

Mathematical Processes

- PS.2: Reason abstractly and quantitatively.
- PS.4 Model with mathematics.

Resources

Proficiency Scales	Digital	Manipulatives
• G.TS.4	• IDOE Examples/Tasks G.TS.4 • IDOE Examples/Tasks G.QP.5 • IDOE Examples/Tasks G.QP.6 • IDOE Examples/Tasks G.TS.1 • IDOE Examples/Tasks G.TS.2 • IDOE Examples/Tasks G.TS.3 • IDOE Examples/Tasks G.TS.5	• **3D Geometric Solids** • Coordinate Grid • Paper Net Layouts • Scientific Calculator • Virtual Prisms • Virtual Pyramids • Virtual Platonic Solids

School Resources

Textbook	Formative Assessments

General Description of the Unit

In this unit students will investigate aspects of circles. They will draw tangents to circles and see how a tangent to a circle is related to the radius at the point of tangency. Students will use intercepted arcs of circles to measure angles formed by chords in a circle and to measure angles formed by secants and tangents to a circle. Students will explore the relationships between segment lengths of chords that intersect in a circle and the relationships between segment lengths of secants and tangents to a circle. They will also explore the relation of arc lengths and circumferences to areas of sectors and circles.

Priority Standards

- **G.CI.2:** Derive the fact that the length of the arc intercepted by an angle is proportional to the radius; derive the formula for the area of a sector.

Supporting Standards

- **G.CI.1:** Define, identify and use relationships among the following: radius, diameter, arc, measure of an arc, chord, secant, tangent, congruent circles, and concentric circles.
- **G.CI.3:** Explore and use relationships among inscribed angles, radii, and chords, including the following:
  - The relationship that exists between central, inscribed, and circumscribed angles.
  - Inscribed angles on a diameter are right angles.
  - The radius of a circle is perpendicular to a tangent where the radius intersects the circle.
- **G.CI.4:** Solve real-world and other mathematical problems that involve finding measures of circumference, areas of circles and sectors, and arc lengths and related angles (central, inscribed, and intersections of secants and tangents).
- **G.CI.5:** Use tools to explain and justify the process to construct a circle that passes through three given points not on a line, a tangent line to a circle through a point on the circle, and a tangent line from a point outside a given circle to the circle.
- **G.CI.6:** Use tools to construct the inscribed and circumscribed circles of a triangle. Prove properties of angles for a quadrilateral inscribed in a circle.

Enduring Understandings

- Formulas for arc length and sector area give us the tools needed to examine slices of a circle.
- There are a variety of angles, segments, and arcs that can be formed in a circle; knowing the relationships resulting from these pieces gives us tools to solve for different parts of a circle.
- We can use tools to construct a circle that meets specified characteristics.

Essential Questions

- In what settings would it be helpful to be able to calculate arc length? Sector area?
- How are the area and circumference of a circle related?
- Why is it important to define and understand so many relationships in a circle?
- Why are constructions important in geometry?

Key Concepts

- Through exploration, I can derive the fact that the length of the arc intercepted by an angle is proportional to the radius. (G.CI.2)
- Through exploration, I can derive the formula for the area of a sector. (G.CI.2)
- I can find arc lengths. (G.CI.2)
- I can use proportional relationships to find the area of sectors. (G.CI.2)

Related Concepts

- I can label all parts of a circle. (G.CI.1)
- I can solve problems involving tangent lines to circles. (G.CI.1)
- I can find measures of angles and arcs. (G.CI.1)
- I can determine whether an arc is a major arc or a minor arc. (G.CI.1)
- I can distinguish between chords, secants, and tangents. (G.CI.1)
- I can discuss concentric circles in terms of similarity. (G.CI.1)

Vocabulary

- Arc
- Arc length
- Area of a circle
- Area of a sector
- Central angle
- Chord
- Circumcenter
- Circumference
- Circumscribed angles
- Circumscribed Circle
- Congruent concentric circles
- Diameter
- Incenter

	• I can explore the relationship that exists between central, inscribed, and circumscribed angles. (G.CI.3) • I can determine the significance of the measure of an inscribed angle on a diameter and use that understanding to solve problems. (G.CI.3) • I can apply my understanding arcs, angles, and chords to solve circle related problems. (G.CI.3) • I can explore the relationship between a radius and a tangent when they are perpendicular at their intersection. (G.CI.3) • I can solve real-world problems involving circles and all their parts. (G.CI.4) • I can use formulas to find missing arc lengths and related angles. (G.CI.4) • I can select an appropriate tool when asked to explain and justify geometric constructions. (G.CI.5) • I can construct the tangent line to a circle through a given exterior point. (G.CI.5) • I can construct the tangent line to a circle through a point on the circle. (G.CI.5) • I can justify my thinking when constructing tangents to a circle. (G.CI.5) • I can select an appropriate tool when asked to explain and justify geometric constructions. (G.CI.6) • I can construct an inscribed circle of a triangle. (G.CI.6) • I can construct a circumscribed circle of a triangle. (G.CI.6) • I can prove the properties of angles for a quadrilateral inscribed in a circle. (G.CI.6)	• Inscribed angle • Inscribed Circle • Inscribed Quadrilateral • Intercepted arc • Measure of an arc • Perpendicular • Proportional • Radius • Secant • Similarity • Tangent

Mathematical Processes

- PS.1: Make sense of problems and persevere in solving them.
- PS.3: Construct viable arguments and critique the reasoning of others.

Resources

Proficiency Scales	Digital	Manipulatives
• G.CI.2	• IDOE Examples/Tasks G.CI.2 • IDOE Examples/Tasks G.CI.1 • IDOE Examples/Tasks G.CI.3 • IDOE Examples/Tasks G.CI.4 • IDOE Examples/Tasks G.CI.5 • IDOE Examples/Tasks G.CI.6	• Compass • Desmos Geometry • Geogebra Geometry Circles Unit • Protractor • Scientific Calculator • **Straightedge** • Two-Column Proof

School Resources

Textbook	Formative Assessments