

# Geometry Honors Unit 3: Polygons, Quadrilaterals & Similarity (Gr. 9 - 10)

Content Area: **Mathematics**  
Course(s): **Geometry Honors**  
Time Period: **2nd Marking Period**  
Length: **8 Weeks**  
Status: **Published**

## Unit Overview

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This unit opens with a review of polygon vocabulary and the investigation of the interior and exterior angle measures of convex polygons and, more specifically, regular polygons. From there, students will move on to study quadrilaterals. They will investigate the properties of parallelograms, how these can be used to solve problems related to parallelograms, and the unique properties of special parallelograms, trapezoids and kites. Students will be asked to prove that specific quadrilaterals are parallelograms, rectangles, rhombi, or squares. From here, students will move on to investigate dilations and the properties and uses of similar polygons.

By the end of January, administer the [Link IT CC Geometry Form B TEI](#)

## Transfer

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

- Determine the properties of polygons and quadrilaterals that are pertinent to solving various problems.
- Identify dilations and similar polygons as they occur in nature, art, and other applications.
- Sketch dilations and similar polygons to meet given criterion.
- Use proportional reasoning to solve applied problems as they arise.

## Meaning

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## Understandings

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Students will understand that...

- Geometric relationships and definitions can be used to construct geometric figures and solve real-world problems.
- The more sides that a convex polygon has, the greater the sum of its interior angles.
- The sum of the exterior angles of a convex polygon is consistent, regardless of the number of sides that the polygon has.

- The unique properties of parallelograms and other special quadrilaterals allow us to solve for unknowns involving these quadrilaterals.
- All figures can be dilated to produce similar figures.
- When one figure is dilated to produce another, similar figures result.
- Similar polygons have congruent corresponding angles, and side lengths that are in proportion to one another.
- There are shortcuts that can be used to show that two triangles are similar.

## **Essential Questions**

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Students will keep considering...

- How can geometric figures and their properties be described by careful use of geometric language?
- Why is it useful to classify geometric figures?
- How can various geometric properties be verified by using the coordinate plane?
- How can a desired image be produced through the manipulation of a given figure in a plane?
- How are transformations used in various careers and in the real world?

## **Application of Knowledge and Skill**

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### **Students will know...**

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- The names of polygons with ten or fewer sides.
- The formulas used to determine angle measures related to polygons.
- The definitions and unique characteristics of parallelograms, rectangles, rhombi, squares, trapezoids and kites.
- That transformations produce similar figures.
- The definition and properties of similar polygons.
- That the AA Postulate, SAS and SSS Similarity Theorems can be used to prove triangles similar.
- The Triangle Proportionality Theorems and the Triangle Angle Bisector Theorem.
- That ratios and proportions are useful in a variety of applications.
- That all circles are similar.

### **Students will be skilled at...**

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- Calculating the interior and exterior angle sums of polygons, as well as individual angle measures in regular polygons.

- Classifying polygons based on given angle measurements.
- Identifying parallelograms, rectangles, rhombi, squares, trapezoids, kites, and similar figures.
- Using the properties of parallelograms and special parallelograms to solve for unknowns.
- Using given information to prove that certain quadrilaterals are parallelograms, rectangles, rhombi, or squares.
- Using the properties of trapezoids and kites to solve for unknowns.
- Identifying the scale factor for similar polygons.
- Verifying that given polygons are similar.
- Proving that triangles are similar.
- Solving for unknown measurements in similar polygons.
- Using proportional relationships to solve for unknowns.

## Academic Vocabulary

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- base angle of a trapezoid
- base of a trapezoid
- concave
- convex
- decagon
- diagonal
- dilation
- directed line segment
- heptagon
- hexagon
- indirect measurement
- isosceles trapezoid
- kite
- leg of a trapezoid
- midsegment of a trapezoid
- n-gon
- nonagon
- octagon
- parallelogram
- pentagon
- proportion
- quadrilateral
- ratio
- rectangle
- regular polygon

- rhombus
- scale
- scale drawing
- scale factor
- side of a polygon
- similar
- similar polygons
- similarity ratio
- similarity transformations
- square
- trapezoid
- vertex of a polygon

### **Learning Goal 3.1**

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Students will prove and apply theorems about polygons and quadrilaterals.

- Students will prove and apply theorems about polygons and quadrilaterals.

### **Target 3.1.1 (Level of Difficulty: Retrieval, DOK: 1 - Recall)**

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SWBAT classify polygons according to their sides and angles.

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.K-12.6	Attend to precision.

### **Target 3.1.2 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)**

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SWBAT develop and use formulas to determine the following angle measures in given polygons. Given these angle measures, SWBAT determine the associated polygon.

- The sum of the measures of the interior and exterior angles
- The measure of one interior or exterior angle of a regular polygon

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-12.6	Attend to precision.
MA.K-12.8	Look for and express regularity in repeated reasoning.

### **Target 3.1.3 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)**

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SWBAT prove properties of parallelograms, as well as apply these properties in solving for unknowns.

MA.G-CO.C.11	Prove theorems about parallelograms.
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.

### **Target 3.1.4 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)**

SWBAT use the properties of given quadrilaterals to determine whether they are parallelograms. When appropriate, SWBAT prove that given quadrilaterals are parallelograms.

MA.G-CO.C.11	Prove theorems about parallelograms.
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.

### **Target 3.1.5 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)**

SWBAT prove properties of rectangles, rhombuses, and squares, as well as use these properties in solving for unknowns.

MA.G-CO.C.11	Prove theorems about parallelograms.
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-SRT.B.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

### **Target 3.1.6 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)**

SWBAT prove that a given quadrilateral is a rectangle, rhombus, or square.

SWBAT prove that a quadrilateral with given vertices in the coordinate plane is a rectangle, rhombus, or square.

MA.G-CO.C.11	Prove theorems about parallelograms.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.G-GPE.B.4	Use coordinates to prove simple geometric theorems algebraically.

### **Target 3.1.7 (Level of Difficulty: Comprehension, DOK: 2 - Skill)**

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SWBAT identify and use the properties of trapezoids to solve problems.

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.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.K-12.7	Look for and make use of structure.
MA.G-SRT.B.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

### **Target 3.1.8 (Level of Difficulty: Comprehension, DOK: 2 - Skill)**

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SWBAT identify and use the properties of kites to solve problems.

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.K-12.7	Look for and make use of structure.
MA.G-SRT.B.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

### **Target 3.1.9 (Level of Difficulty: Comprehension, DOK: 2 - Skill)**

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Given a rectangle, parallelogram, trapezoid, or regular polygon, SWBAT describe the rotations and reflections that carry it onto itself.

MA.G-CO.A.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.7	Look for and make use of structure.

### **Learning Goal 3.2**

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Students will understand similarity in terms of similarity transformations, and will solve problems involving similar polygons.

- Students will understand similarity in terms of similarity transformations, and will solve problems involving similar polygons.

### **Target 3.2.1 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)**

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SWBAT verify experimentally the properties of dilations given by a center and a scale factor:

- A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
- The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

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-12.5	Use appropriate tools strategically.
MA.G-SRT.A.1	Verify experimentally the properties of dilations given by a center and a scale factor:
MA.G-SRT.A.1a	A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
MA.G-SRT.A.1b	The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

### **Target 3.2.2 (Level of Difficulty: Comprehension, DOK: 2 - Skill)**

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SWBAT define similarity in terms of similarity transformations. Based on this definition, students will determine when two polygons are similar.

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.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-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.G-SRT.A.2	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

### **Target 3.2.3 (Level of Difficulty: Comprehension, DOK: 2 - Skill)**

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SWBAT identify properties of similar polygons, and apply these properties 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-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.7	Look for and make use of structure.
MA.G-SRT.A.2	Given two figures, use the definition of similarity in terms of similarity transformations to

decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

MA.G-SRT.B.5

Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

### **Target 3.2.4 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)**

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SWBAT prove that all circles are similar.

MA.G-C.A.1

Prove that all circles are similar.

MA.K-12.3

Construct viable arguments and critique the reasoning of others.

### **Target 3.2.5 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)**

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SWBAT use the properties of similarity transformations to establish the AA, SSS, and SAS criterion for two triangles to be similar. SWBAT prove that given triangles are similar.

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.K-12.6

Attend to precision.

MA.G-SRT.A.2

Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

MA.G-SRT.A.3

Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

MA.G-SRT.B.5

Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

### **Target 3.2.6 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)**

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SWBAT prove and apply the Triangle Proportionality Theorem, its converse, and the Triangle Angle Bisector Theorems in solving for unknown lengths.

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.K-12.7

Look for and make use of structure.

MA.G-SRT.B.4

Prove theorems about triangles.

MA.G-SRT.B.5

Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.



### **Target 3.2.7 (Level of Difficulty: Comprehension, DOK: 2 - Skill)**

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SWBAT use ratios and scale drawings to make indirect measurements and solve problems.

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.K-12.7	Look for and make use of structure.
MA.G-SRT.B.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

### **Target 3.2.8 (Level of Difficulty: Comprehension, DOK: 2 - Skill)**

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SWBAT apply properties of similarity to figures in the coordinate plane.

MA.G-CO.A.2	Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
MA.G-MG.A.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
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.G-SRT.A.1	Verify experimentally the properties of dilations given by a center and a scale factor:
MA.G-SRT.A.1a	A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
MA.G-SRT.A.1b	The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

### **Target 3.2.9 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)**

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SWBAT use coordinate proof to prove that figures in the coordinate plane are similar.

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.G-GPE.B.4	Use coordinates to prove simple geometric theorems algebraically.

### **Target 3.2.10 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)**

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SWBAT find the point on a directed line segment between two given points that partitions the segment in a

given ratio.

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.B.6	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

## **21st Century Life and Careers**

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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**

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- Projects
- Quizzes
- Student Portfolios
- Tests
- Unit 1 Assessment (Common Assessment)

## **Formative Assessment and Performance Opportunities**

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- "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**

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- 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**

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- 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/spreadsheet/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/>