

Unit 3: Transformations, Similarity, and Polygons

Content Area: **Mathematics**
Course(s): **Geometry**
Time Period: **3rd Marking Period**
Length: **11 weeks**
Status: **Published**

Unit Overview

Through this unit, students will investigate transformations, with a focus on isometries. They will define, sketch, and compare various transformations, as well as describe the transformations that can be used to map one figure onto another. Then they will continue with a study of dilations which leads into the exploration of similar polygons and their properties. Next, students will review polygon vocabulary and develop formulas used to find the interior and exterior angle measures of convex polygons. From there, students will move on to study quadrilaterals. They will investigate and prove the properties of parallelograms and special parallelograms, as well as use these to solve for unknowns in applied problems.

By the end of January, administer the Link IT NJSLs Geometry Form B TEI

Transfer

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

- Transform figures in a plane.
- Determine when figures are congruent.
- 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.
- Determine the properties of polygons and quadrilaterals that are pertinent to solving various problems.
- Write valid geometric proofs to demonstrate the properties of lines, angles, triangles, and special quadrilaterals.

Meaning

Understandings

Students will understand that...

- Geometric relationships and definitions can be used to construct geometric figures and solve real-world problems.

- Isometries are transformations that do not change the size or shape of a figure.
- An object in a plane can be oriented infinitely many different ways while maintaining its size, shape, and original properties.
- Specific instructions can be used to produce a desired image through the manipulation of a given image.
- 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.
- 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.

Essential Questions

Students will keep considering...

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

Application of Knowledge and Skills

Students will know...

- That transformations are functions that take points in the plane as inputs and give other points as outputs.
- The definitions of reflections, rotations, translations, and symmetry.
- The properties of isometries.
- That all corresponding parts of congruent figures are congruent.
- That transformations produce similar figures.
- The definition and properties of similar polygons.
- That ratios and proportions are useful in a variety of applications.
- 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.

Students will be skilled at...

- Drawing specified transformations of figures.
- Specifying a sequence of transformations that will carry a given figure onto another.
- Identifying symmetry in figures.
- Identifying the scale factor for similar polygons.
- Verifying that given polygons are similar.
- Solving for unknown measurements in similar polygons.
- Using proportional relationships to solve for unknowns.
- 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 unique quadrilaterals to solve for unknowns.
- Using given information to prove that certain quadrilaterals are parallelograms, rectangles, rhombuses, or squares.

Academic Vocabulary

- area
- base angle of a trapezoid
- base of a trapezoid
- composition of transformations
- concave
- congruent polygons
- convex
- decagon
- diagonal
- glide reflection
- glide reflection symmetry
- heptagon
- hexagon
- included angle
- included side
- indirect measurement
- isometry
- isosceles trapezoid
- justify
- kite
- leg of a trapezoid
- line of symmetry

- line symmetry
- midsegment of a trapezoid
- n-gon
- nonagon
- octagon
- parallelogram
- pentagon
- proportion
- prove
- quadrilatetral
- ratio
- rectangle
- reflection
- regular polygon
- rhombus
- rigid motion
- rotation
- rotational symmetry
- scale drawing
- scale factor
- side of a polygon
- similar
- similar polygons
- similarity ratio
- similarity transformations
- square
- surface area
- symmetry
- transformation
- translation
- translation symmetry
- trapezoid
- vertex of a polygon
- volume

Learning Goal 3.1

Students will identify the properties of, sketch, and describe transformations in the plane.

Daily Target 3.1.1 (Level of Difficulty: Comprehension, DOK: 2-Skill)

Students will draw transformed figures using graph paper, tracing paper, and/or geometry software.

MA.G-CO.A.5	Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
MA.G-CO.B.6	Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.

Daily Target 3.1.2 (Level of Difficulty: Comprehension, DOK: 2-Skill)

SWBAT describe a transformation F as a function that assigns each point P in the plane to a point $F(P)$ of the plane, and will develop formal mathematical definitions of reflection, rotation, and translation.

Defining Rotations: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/4/tasks/1509>

LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
MA.G-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-CO.A.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
MA.K-12.7	Look for and make use of structure.

Daily Target 3.1.3 (Level of Difficulty: Comprehension, DOK: 2-Skill)

SWBAT draw compositions of transformations.

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-CO.A.5	Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
MA.G-CO.B.6	Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.

MA.K-12.7

Look for and make use of structure.

Learning Goal 3.2

Students will verify the properties of dilations given by a center and a scale factor.

Daily Target 3.2.1 (Level of Difficulty: Comprehension, DOK: 2-Skill)

SWBAT dilate figures in the coordinate plane. Given a figure and its dilated image, SWBAT identify the center of dilation and the scale factor.

MA.K-12.5

Use appropriate tools strategically.

MA.K-12.6

Attend to precision.

MA.G-SRT.A.1

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

Daily Target 3.2.2 (Level of Difficulty: Knowledge Utilization, DOK: 4-Extended Thinking)

SWBAT describe the effect of given dilations on lines and line segments:

- 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.

Dilating a Line: <https://www.illustrativemathematics.org/content-standards/HSG/SRT/A/1/tasks/602>

MA.K-12.1

Make sense of problems and persevere in solving them.

MA.K-12.2

Reason abstractly and quantitatively.

MA.K-12.5

Use appropriate tools strategically.

MA.K-12.8

Look for and express regularity in repeated reasoning.

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.

Learning Goal 3.3

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

Daily Target 3.3.1 (Level of Difficulty: Comprehension, DOK: 2-Skill)

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.

Daily Target 3.3.2 (Level of Difficulty: Knowledge Utilization, DOK: 4-Extended Thinking)

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

Daily Target 3.3.3 (Level of Difficulty: Comprehension, DOK: 2-Skill)

SWBAT draw and describe transformations, and apply similarity properties in the coordinate plane.

MA.G-CO.B.6	Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
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-12.6	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.

Learning Goal 3.4

Students will prove and apply theorems about polygons and quadrilaterals, and will solve related problems.

Daily Target 3.4.1 (Level of Difficulty: Retrieval, DOK: 1-Recall)

SWBAT classify polygons and quadrilaterals according to their sides, angles, and unique properties.

LA.RH.9-10.4	Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history and the social sciences; analyze the cumulative impact of specific word choices on meaning and tone.
MA.K-12.6	Attend to precision.

Daily Target 3.4.2 (Level of Difficulty: Analysis, DOK: 3-Strategic Thinking)

SWBAT develop and use formulas to determine the following measures in given convex polygons. Given any of these unique measures, SWBAT determine the associated polygon.

- The sum of the measures of the interior angles
- The sum of the measures of the exterior angles (360°)
- The measure of one interior angle of a regular polygon
- The measure of one 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.

Daily Target 3.4.3 (Level of Difficulty: Knowledge Utilization, DOK: 4-Extended Thinking)

Students will use congruence criteria for triangles (CPCTC) to construct and explain formal proofs of theorems involving parallelograms, including:

- Opposite sides are congruent
- Opposite angles are congruent
- The diagonals of a parallelogram bisect each other

Is this a parallelogram? <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/11/tasks/1321>

Midpoints of the Sides of a Parallelogram: <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/11/tasks/35>

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

Daily Target 3.4.4 (Level of Difficulty: Comprehension, DOK: 2-Skill)

SWBAT use properties of given quadrilaterals to determine whether they are parallelograms.

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

Daily Target 3.4.5 (Level of Difficulty: Knowledge Utilization, DOK: 4-Extended Thinking)

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-12.6	Attend to precision.
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.

Daily Target 3.4.6 (Level of Difficulty: Analysis, DOK: 3-Strategic Thinking)

SWBAT apply the properties of special quadrilaterals in solving for unknowns. (Squares, Rectangles, Rhombuses, Kites, Trapezoids)

MA.G-CO.C.11	Prove theorems about parallelograms.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.

Learning Goal 3.5

Students will explain and apply area and volume formulas to solve for specific unknowns.

LGBTQ Connections: Area and volume word problems can mention that Jasmine and their moms/dads are

looking for new furniture to fit in various rooms in their new home. They need to use the area/volume formulas to assist in the process of packing by finding the amount of space they have in each moving box/bin, as well as fitting new furniture by finding the amount of space they have in each new room. Also, this same scenario can say, for example, "Kyle and his fiance (or husband), Miguel are looking for new furniture for their new home..."

Daily Target 3.5.1 (Level of Difficulty: Analysis, DOK: 3-Strategic Thinking)

SWBAT find the perimeters and areas of polygons in the coordinate plane, applying the Pythagorean Theorem and/or distance formula as needed.

Triangle Perimeters: <https://www.illustrativemathematics.org/content-standards/HSG/GPE/B/7/tasks/1816>

MA.G-MG.A.2	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
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-12.3	Construct viable arguments and critique the reasoning of others.
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-GMD.A.1	Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
MA.G-GPE.B.7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Daily Target 3.5.2 (Level of Difficulty: Analysis, DOK: 3-Strategic Thinking)

SWBAT find surface areas and volumes of polygons in the coordinate plane.

MA.G-MG.A.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).
MA.G-MG.A.2	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
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-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.

MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.G-GMD.A.1	Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
MA.G-GMD.A.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

21st Century Life and Careers

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP11	Use technology to enhance productivity.
CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.

Technology

TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.D.CS1	Advocate and practice safe, legal, and responsible use of information and technology.
TECH.8.1.12.D.CS2	Demonstrate personal responsibility for lifelong learning.
TECH.8.1.12.E.CS1	Plan strategies to guide inquiry.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS3	Evaluate and select information sources and digital tools based on the appropriateness for specific tasks.
TECH.8.2.12.D.CS2	Use and maintain technological products and systems.

Formative Assessment and Performance Opportunities

- Academic Games
- Albert
- Carousel Activities
- Class Discussions

- Classwork
- Closure Activities
- Concept Sorting Activities
- Desmos Activities
- Do Nows
- Edpuzzle
- Edulastic
- Exit Tickets
- Four Corners Activities
- Graphic Organizers
- Homework
- Kahoot! Games
- Placemat Activities
- Question-All-Writes
- Quizizz Activities
- Quiz-Quiz-Trade Activities
- Station Activities
- Student Interviews
- Student Self-Rating
- Teacher Observation
- Teacher Questioning
- Think, Pair, Share Discussions
- Thumbs Up/Down
- Turn and Talk Discussions
- Whip Around
- Whiteboard Use

Summative Assessment

- Projects
- Quizzes
- Tests
- Unit Exam

Accommodations and Modifications

- 504 Accommodations
- Challenge Problems
- Graphic Organizers

- Guided Notes
- IEP Modifications
- Learning Centers/Stations
- Leveled Practice Opportunities
- Projects
- Scaffolding Questions
- Small Group Instructions
- Student Companion Website Resources
- Technology
- Use of Manipulatives (Paper Strips, Exploragons, etc)

Unit Resources

- Albert
- Desmos
- Geometer's Sketchpad
- Google Classroom
- Kahoot!
- Kuta Software
- Loom
- Quizizz
- Textbook: Geometry, Common Core Ed. (Holt McDougal, 2012)
- Textbook Resource Kit & Companion Website: <https://my.hrw.com/>
- Youtube

Additional Websites:

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

Interdisciplinary Connections

- Origami
- Similar Triangles Project
- Tessellations Project
- Transformations Project

VA.9-12.1.5.12prof.Pr5	Developing and refining techniques and models or steps needed to create products.
VA.9-12.1.5.12prof.Cr1a	Use multiple approaches to begin creative endeavors.
VA.9-12.1.5.12prof.Cr1b	Shape an artistic investigation of an aspect of present-day life using a contemporary practice of art and design.
VA.9-12.1.5.12prof.Cr2c	Collaboratively develop a proposal for an installation, artwork, or space design that transforms the perception and experience of a particular place.
VA.9-12.1.5.12prof.Pr4a	Analyze, select and curate artifacts and/or artworks for presentation and preservation.
VA.9-12.1.5.12prof.Re9a	Establish relevant criteria in order to evaluate a work of art or collection of works.
VA.9-12.1.5.12prof.Cn11a	Describe how knowledge of culture, traditions and history may influence personal responses to art.