Transformations and the Pythagorean Theorem

Content Area: **Math**
Course(s): **Math Grade 8**
Time Period: **MP3**
Length: **45**
Status: **Published**

Unit Overview

Unit Summary	Unit Rationale
Students understand the concept of translating figures and how the resulting images are related to the preimages. Students will also understand the concept of reflecting figures and recognize how the image is a flip of a preimage and that the two figures are an equal distance away from the line of reflection. Students will also develop their understanding of dilation to find and graph images. In this unit students will also recognize that congruent figures have the same shape and size. They know that congruent images are created by a sequence of reflections, rotations, and translations. In this unit, students recognize that parallel lines and a transversal create sets of angles. They will learn that there are angle-based relationships that can be used to categorize and determine the measures of unknown angles. Students will also build on their understanding of angle-based relationships and determine the missing measurements of interior and exterior angles of triangles. This unit also focuses on the Pythagorean Theorem. In order for students to be successful in using the Pythagorean Theorem, they must recognize that the hypotenuse of a right triangle is the longest side and is opposite the right angle. The legs are adjacent to the right angle and can have equal or different measures. Students understand that absolute value can be used to find any distance on the coordinate plane, including diagonal distances.	Unit 3 allows students to develop procedure and fluency related to the topics related to Geometry including, congruence, similarity, transformations and the Pythagorean Theorem. In this unit students also develop conceptual understanding related these topics. These are foundational skills for upper level geometry classes. This unit also helps students to see the connection between algebraic reasoning and geometry. The lessons in this unit will also help students to develop a geometric view of the world around them and how these skills are visible in the world around them.

NJSLS

8.G.A.1.a	Lines are transformed to lines, and line segments to line segments of the same length.
8.G.A.1.b	Angles are transformed to angles of the same measure.
8.G.A.1.c	Parallel lines are transformed to parallel lines.
8.G.A.2	Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
8.G.A.3	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
8.G.A.4	Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.
8.G.A.5	Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.
8.G.B.6	Explain a proof of the Pythagorean Theorem and its converse.
8.G.B.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
8.G.B.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Standards for Mathematical Practice

1	Make sense of problems and persevere in solving them
2	Reason abstractly and quantitatively
3	Construct viable arguments and critique the reasoning of others
4	Model with mathematics
5	Use appropriate tools strategically
6	Attend to precision
7	Look for and make use of structure
8	Look for and express regularity in repeated reasoning

Unit Focus

Enduring Understandings	Essential Questions
• A translation (slide) is a transformation that moves every point of a figure the same distance and the same direction. • A reflection (flip) creates images that have the same size and shape, but different orientation. The preimage and image are the same distance from the line of reflection but on opposite sides. • A rotation is created by moving each point of	• How does a translation affect the properties of a two-dimensional figure? • How does a reflection affect the properties of a two-dimensional figure? • How does a rotation affect the properties of a two-dimensional figure? • How can you use a sequence of transformations to map a preimage to its image?

the preimage around a fixed point. The image and preimage have the same size, shape, and orientation. • When one transformation will not map a preimage into its image, a sequence of transformations is needed. • A sequence of translations, reflections, and rotations can map one figure to another without changing its shape or size. • A dilation is a transformation that changes the size of a figure. In a dilation, the preimage and image have the same shape, angle measures, and proportions. • Two-dimensional figures are similar if there is a sequence of translations, reflections, and dilations that map one figure onto the other. • If parallel lines are intersected by a transversal, then corresponding and alternate interior angles are congruent, and same-side interior angles are supplementary. • The Pythagorean Theorem can be used to determine if a triangle is a right triangle and to find the missing side length of a triangle. • If a triangle has side length such that a2 + b2 = c2, the triangle is a right triangle. • The Pythagorean Theorem and its converse can be used to solve real-world problems that involve right triangles. Both can be used to determine the unknown leg lengths of a right triangle, or to identify or verify whether a triangle is a right triangle. • The Pythagorean Theorem can be used to find the distance between any two points on a coordinate plane by drawing a line to connect the points and using it as the hypotenuse of a right triangle where the legs are the horizontal and vertical distances.	• How does a sequence of translations, reflections, and rotations result in congruent figures? • What is the relationship between a preimage and its image after a dilation? • How are similar figures related by a sequence of transformations? • What are the relationships among angles that are created when a line intersects two parallel lines? • How are the interior and exterior angles of a triangle related? • How can you use angle measures to determine whether two triangles are similar? • How does the Pythagorean Theorem relate the side lengths of a right triangle? • How can you determine whether a triangle is a right triangle? • What types of problems can be solved using the Pythagorean Theorem. • How can you use the Pythagorean Theorem to find the distance between two points?

Instructional Focus

Learning Targets
• Understand translations • Translate a figure on a coordinate plane

- Describe a translation
- Understand and describe a reflection
- Reflect two-dimensional figures
- Identify and perform a rotation
- Determine how a rotation affects a two-dimensional figure.
- Understand a sequence of transformations
- Describe and perform a sequence of transformations
- Understand congruence of figures using a series of transformations.
- Identify congruent figures
- Understand dilations
- Dilate to enlarge or reduce a figure in a coordinate plane
- Understand similarity
- Complete a similarity transformation
- Identify similar figures
- Understand the relationships of angles formed by parallel lines and a transversal
- Find unknown angle measures
- Understand the relationship of the interior angles of a triangle.
- Find unknown angle measures
- Determine whether triangles are similar
- Solve problems involving similar triangles
- Understand the Pythagorean Theorem
- Given two side lengths of a right triangle, use the Pythagorean Theorem to find the length of the third side
- Understand why the Converse of the Pythagorean Theorem is true
- Apply the Converse of the Pythagorean Theorem to analyze two-dimensional shapes
- Apply the Pythagorean Theorem and its converse to solve real-world problems
- Apply the Pythagorean Theorem to solve problems that involve three dimensions
- Apply the Pythagorean Theorem to find the distance between two points on a map or coordinate plane.
- Find the perimeter of a figure on a coordinate plane
- Identify the coordinates of the third vertex of a triangle on the coordinate plane

Prerequisite Skills

- Multiplication of fractions
- Square roots
- Parts of a graph
- Slope
- Properties of parallel and perpendicular lines
- Angle relationships from previous years

Common Misconceptions

- Students may only express the positive square root in the solution.
- Students often think cube roots also have 2 solutions.
- Cube and square root problems are division by 2 or 3.
- Students mislabel the legs and hypotenuse of a right triangle or incorrectly substitute values to use the Pythagorean Theorem.

- When using PT in a coordinate plane, students often find the slope of the line instead of the length of the line.
- Students attempt to memorize Transformation rules instead of learning how to use them.
- Students may forget to move each point using the same rule.

Spiraling For Mastery

Current Unit Content/Skills	Spiral Focus	Activity
• Transformations • Pythagorean Theorem	• Geometry (Grade 6 and 7) • Triangles (grade 7) • Solve Problems Using Equations (Grade 7) • Number System (Grade 8)	• Math Diagnostic and Intervention System

Assessment

Formative Assessment	Summative Assessment
• Homework • Lesson Checks • MathXL • Quizzes • Exit Tickets • Lesson Reflections • Performance Tasks	• Topic Tests • Unit 3 Benchmark (Link-It)

Resources

Key Resources	Supplemental Resources
• Savvas EnVision Grade 8 • Pacing Guide	• IXL • Delta Math • Desmos • Khan Academy • Manuevering the Middle

Career Readiness, Life Literacies, and Key Skills

9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
9.4.8.CT.2	Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).
9.4.8.GCA.1	Model how to navigate cultural differences with sensitivity and respect (e.g., 1.5.8.C1a).
9.4.8.GCA.2	Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
9.4.8.IML.3	Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping (e.g., 6.SP.B.4, 7.SP.B.8b).
9.4.8.TL.3	Select appropriate tools to organize and present information digitally.
9.4.8.TL.6	Collaborate to develop and publish work that provides perspectives on a real-world problem.

Interdisciplinary Connections

L.KL.8.2	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
L.KL.8.2.A	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases.
L.VL.8.3	Determine or clarify the meaning of unknown and multiple-meaning words or phrases based on grade 8 reading and content, including technical meanings, choosing flexibly from a range of strategies.
SL.PE.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
SL.PE.8.1.A	Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
SL.PE.8.1.B	Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.
SL.PE.8.1.C	Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
SL.PE.8.1.D	Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

6-8.MS-ETS1-3.ETS1.B.1	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
6-8.MS-ETS1-3.ETS1.B.2	Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.