Unit 04 - Symmetry and Transformations

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **24 days**
Status: **Published**

General Overview, Course Description or Course Philosophy

In Grade 8, instructional time should focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

In this unit, students develop an understanding of congruence and similarity of geometric figures, and the mathematical techniques for finding and applying those relationships of shapes. The two main topics of the unit that highlight congruence and similarity are rigid motions (translations, reflections, rotations) and dilation.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Essential Questions:

- Why does one need to perform transformations on figures?
- How does knowing two figures are congruent or similar help one to solve problems?
- What are the properties of a reflection, rotation, and translation transformation?
- What techniques can be used to explore rigid motion transformations to create symmetric designs?
- How are coordinate rules used for basic rigid motion transformations?
- How can a sequence of reflections, rotations, and/or translations be used to determine if two figures are congruent?
- How can a sequence of reflections, rotations, translations, and/or dilations be used to determine that two figures are similar?
- How can transformations be used to describe a sequence that exhibits the congruence between figures?
- How are the properties of angles formed by parallel lines and a transversal related to the angle sum in any triangle and to properties of transformations?
- How can properties of congruent and similar triangles be used to solve problems about shapes and measurements?

Enduring Understandings:

- Rotations, reflections, and translations take:
    - lines to lines
    - line segments to line segments of the same length
    - angles to angles of the same measure

    - parallel lines to parallel lines
- 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.
- 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.
- There are relationships between the interior and exterior angles of a triangle.
- There are relationships among the angles formed when parallel lines are cut by a transversal.
- When two angles of one triangle are congruent to two angles of another triangle, the third angles are also congruent.
- On its own, congruence of corresponding angles determines similarity only for triangles.
- Various transformations affect distances and angles of figures differently. These effects help compare figures and determine the similarity or congruence between figures.
- Two shapes are congruent if a specific sequence of rigid transformations will transform one shape to the other.
- Two figures are similar if a specific sequence of rigid transformations and dilation will transform one shape to the other.
- Properties of transformations, congruence, and similarity can be used to solve problems about shapes and measurements.

CONTENT AREA STANDARDS

MA.8.G.A.1	Verify experimentally the properties of rotations, reflections, and translations:
MA.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.
MA.8.G.A.3	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
MA.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.
MA.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.
MA.8.G.A.1a	Lines are transformed to lines, and line segments to line segments of the same length.
MA.8.G.A.1b	Angles are transformed to angles of the same measure.
MA.8.G.A.1c	Parallel lines are transformed to parallel lines.
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-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.

MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

CS.K-12.2	Collaborating Around Computing and Design
CS.K-12.3	Recognizing and Defining Computational Problems
CS.K-12.4	Developing and Using Abstractions
CS.K-12.5	Creating Computational Artifacts
CS.K-12.6	Testing and Refining Computational Artifacts
LA.K-12.NJSLSA.R1	Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
LA.K-12.NJSLSA.R4	Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
LA.K-12.NJSLSA.SL4	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
LA.K-12.NJSLSA.SL5	Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- a two-dimensional figure is congruent to one another if the second can be obtained from the first by a sequence of rotations, reflections and translations.
- a two-dimensional figure is similar to another if the second can be obtained through a sequence of rotations, reflections, translations and dilations.
- when working with rotations, reflection, and translations that lines are taken to lines, and line segments to line segments of the same length.
- when working with rotations, reflections, and translations that parallel lines are taken to parallel lines.

Procedural Knowledge

Students will be able to:

- derive the equation y=mx + b for a line intercepting the vertical axis at b.
- derive the equation y=mx for a line through the origin.
- describe a sequence that exhibits the congruence between two congruent figures.
- describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
- use informal arguments to establish facts about the angle sum and exterior angles of triangles.
- use informal arguments to establish facts about the angle-angle criterion for similarity of triangles.
- use informal arguments to establish facts about the angles created when parallel lines are cut by a transversal.
- use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane.
- verify experimentally the properties of angles in rotations, reflections and translations.
- verify experimentally the properties of lines and line segments in rotations, reflections, and translations.
- verify experimentally the properties of parallel lines in rotations, reflections and translations.

EVIDENCE OF LEARNING

Formative Assessments

Mathematical Reflections

Check Up 1

Check Up 2

Self Assessment Take-Home Questions

Delta Math Assignments

Summative Assessments

Partner Quiz

Teacher created assessments (both test generator and teacher generated questions)

OnCourse generated assessments

Delta Math -teacher generated assessments

Unit Project - Making a Wreath and Pinwheel

- Transformation Mystery Picture

RESOURCES (Instructional, Supplemental, Intervention Materials)

Instructional Materials

- CMP3 Unit - Butterflies, Pinwheels and Wallpaper Investigations 1, 2, 3 and 4
- https://www.savvasrealize.com/ (teacher and student recourses)
- Delta Math

Supplemental/Intervention Materials

- deltamath.com
- https://www.khanacademy.org/
  - Transformations
  - Symmetry
- https://illuminations.nctm.org/
  - Inversions
  - Flip-n-slide - Exploring transformations through models
  - Computer Animation
- https://www.illustrativemathematics.org/
  - 8.1 Rigid Transformations and Congruence - All lessons
  - 8.2 Dilations, Similarity, and Introducing Slope - Lessons 1-5

INTERDISCIPLINARY CONNECTIONS

Nature and Art

Graphics Design

Computer Applications

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.