Unit 03: Transformations

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **3 Weeks**
Status: **Published**

Unit 3: Transformations (Modules 5 and 6)

Unit Rationale

In prior learning, students learned basics about transformations and congruence. In this unit, they will define a translation, rotation, and reflection as a function that preserves measure. They will draw the image of a translated, rotated, or reflected figure. They will examine the properties of symmetry in the plane. Later, they will define dilations, stretches, and skews and compare rigid and nonrigid transformations. They will apply sequences of transformations to move figures in the plane. In future units, they will look at congruent triangles and apply the ASA, SAS, SSS, AAS, and HL to prove triangles congruent. They will use similarity transformations to determine whether two figures are similar. They will use similarity to define the trigonometric ratios.

Essential Questions

- What are the key characteristics of different types of transformations?
- How can we describe different types of transformations?
- How do translations affect the position of geometric figures on a coordinate plane?
- Which transformations preserve distance, angle measure, and orientation?
- What are their real-world applications of transformations?
- What are the different types of symmetry, and how do transformations such as reflections and rotations help identify symmetrical figures?
- What distinguishes stretches and skews from other transformations, and how do they affect the geometric properties of shapes?

Pre-Assessments

- Into Geometry: Are you ready? Diagnostic assessment p. 136

Instructional Plan

Define and Apply Transformations (5.1)

Student Learning Intentions or We are learning to … (WALT)

- Develop a definition of translation as a function that preserves measures of segments and angles and then draw the image of a figure under such a transformation.

Student Success Criteria … "I can statements"

- I can tell why a translation is a rigid motion.
- I can describe what a translation vector does to the coordinates of a figure in the coordinate plane.
- I can translate figures in the plane.

Instructional Strategies and Activities

- Into Geometry Spark Your Learning p. 137
- Guided Notes
  - Properties of translations
  - Construct a translation
  - Translate in a coordinate plane
  - Identify a translation vector
- DeltaMath practice assignment
- Into Geometry Practice p. 142

Formative Assessments

- Into Geometry Check Understanding

Instructional Materials and Resources

- Into Math resources
- DeltaMath
- Desmos

Reflections and Suggested Modifications

Define and Apply Rotation (5.2)

Student Learning Intentions or We are learning to … (WALT)

- Develop a definition of rotation as a function that preserves measures of segments and angles, and then draw the image of a figure under such a transformation.

Student Success Criteria … "I can statements"

- I can tell why a rotation is a rigid motion.
- I can describe what a rotation about the origin by a multiple of 90 degrees does to the coordinates of a figure in a coordinate plane.
- I can rotate figures in the plane.

Instructional Strategies and Activities

- Into Geometry Spark Your Learning p. 145
- Guided Notes
    - Explore rotations as rigid motions
    - Construct a rotation
    - Identify parameters of a rotation
    - Rotations in a coordinate plane
    - Rotate a figure onto itself
- DeltaMath practice assignment
- Into Geometry Practice p. 150

Formative Assessments

- Into Geometry Check Your Understanding Interactive Lesson

Instructional Materials and Resources

- Into Math resources
- DeltaMath
- Desmos

Reflections and Suggested Modifications

Define and Apply Reflections (5.3)

Student Learning Intentions or We are learning to … (WALT)

- Develop a definition of reflection as a function that preserves measures of segments and angles, and then draw the image of a figure under such a transformation.

Student Success Criteria … "I can statements"

- I can reflect figures using tracing paper.
- I can reflect figures in a plane.

Instructional Strategies and Activities

- Into Geometry Spark Your Learning p. 153
- Guided Notes
    - Explore reflections as rigid motions
    - Construct a reflection
    - Reflections in a coordinate plane
    - Identify a line of reflection
    - Perform multiple transformations
- DeltaMath practice assignment
- Into Geometry Practice p. 158

Formative Assessments

- Into Geometry Check Your Understanding Interactive Lesson

Instructional Materials and Resources

- Into Math resources
- DeltaMath
- Desmos

Reflections and Suggested Modifications

Define and Apply Symmetry (5.4)

Student Learning Intentions or We are learning to … (WALT)

- Describe the rotations and reflections that carry a given figure onto itself, in order to recognize symmetrical properties of figures and apply these concepts to solve geometric problems.

Student Success Criteria … "I can statements"

- I can differentiate between line symmetry and rotational symmetry.

- I can create a figure that has symmetry.
- I can identify symmetry in figures, and I can explain how to identify lines of symmetry and angles of rotational symmetry to others.

Instructional Strategies and Activities

- Into Geometry Spark Your Learning p. 161
- Guided Notes
    - Explore line symmetry
    - Explore rotational symmetry
    - Describe symmetry in regular polygons
    - Use symmetry in a coordinate plane
- DeltaMath practice assignment
- Into Geometry Practice p. 166

Formative Assessments

- Into Geometry Check Your Understanding Interactive Lesson

Instructional Materials and Resources

- Into Math resources
- DeltaMath
- Desmos

Reflections and Suggested Modifications

Define and Apply Dilations, Stretches, and Compressions (6.1)

Student Learning Intentions or We are learning to … (WALT)

- Perform and analyze transformations to include dilations, stretches, and compressions, and then use coordinate rules and geometric drawing tools to investigate the effect of multiplication on the points in a figure.

Student Success Criteria … "I can statements"

- I can examine a coordinate rule to determine if a figure has undergone a transformation.
- I can write a coordinate rule to dilate or stretch a figure.
- I can dilate and stretch a figure and determine how a figure has been transformed.

Instructional Strategies and Activities

- Into Geometry Spark Your Learning p. 173
- Guided Notes

    - Investigate transformations
    - Explore dilations
    - Use properties of dilations
    - Dilations, stretches, and compressions on the coordinate plane
    - Predict the effect of a transformation rule
- DeltaMath practice assignment
- Into Geometry Practice p. 178

Formative Assessments

- Into Geometry Check Your Understanding Interactive Lesson

Instructional Materials and Resources

- Into Math resources
- DeltaMath
- Desmos

Reflections and Suggested Modifications

Apply Sequences or Transformations (6.2)

Student Learning Intentions or We are learning to … (WALT)

- Apply sequences of transformations to figures, specify sequences that map a given preimage to a given image, and then make predictions about the result of applying a sequence of transformations.

Student Success Criteria … "I can statements"

- I can understand and perform rigid motions on figures in the coordinate plane.
- I can use sequences of transformations to create the image of a figure in a quadrant different from that of its preimage.
- I can determine the effects of a sequence of transformations on a figure.

Instructional Strategies and Activities

- Into Geometry Spark Your Learning p. 181
- Guided Notes
    - Apply two transformations to a figure
    - Apply transformations to map an image back to its preimage
    - Specify a sequence of transformations
    - Write a composition of functions
- DeltaMath practice assignment
- Into Geometry Practice p. 186

Formative Assessments

- Into Geometry Check Your Understanding Interactive Lesson

Instructional Materials and Resources

- Into Math resources
- DeltaMath
- Desmos

Reflections and Suggested Modifications

Modifications and/or Accommodations

Suggested Modifications (ELL, Sp. Ed, GIfted, At-risk of Failure)

English Language Learners

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

Students with 504 Plans

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Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

Modify/Change Activities: Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.

Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media Literacy

Diversity, Equity, and Inclusion

NCTM: Access and Equity in Mathematics Education

A Pathway to Equitable Math Instruction

Provide students with opportunities to give feedback to teachers about the classroom and instruction.

• Verbal Example: Fist to five, How well do you understand what we talked about today? Fist to five, How well did I teach this today?

• Classroom Activity: Exit tickets or surveys that ask students to identify how well teachers taught, what helped them learn, what got in the way of their learning, etc.

Treat mathematics as a language that everyone is learning while authentically centering students home languages.

• Classroom Strategies: Color-coding ideas, learning vocabulary in student languages, visual and kinesthetic learning, representations of learning without words.

• Classroom Activity: Multilingual Frayer Models for definitions or concepts

Incorporate true culturally relevant pedagogy, practice, and curriculum.

• Verbal Example: What are some of your family traditions that you are proud of? Would you be okay if we brought some of those into the classroom?

• Classroom Activity: Use Ankara fabric to teach mathematical concepts such as tessellations, fractions, area, percentages, etc.

Incorporate the history of mathematics into lessons.
• Verbal Example: Why do you think we call it Pythagorean's theorem, when it was used before he was even born? What should we call it instead?
• Classroom Activity: Learn about different bases and numerical ideas: Base 2, binary and connections to computer programming, how the Yoruba of Nigeria used base 20, and how the Mayans conceptualized the number 0 before the first recording of it

Solicit student ways of thinking and processing.
• Verbal Example: How might you all go about this? What do you notice?
• Classroom Activity: Incorporate explorations, where students interact with mathematics in a way that allows them to "discover" or experience mathematics.

Reorganize your classroom teaching around concepts, and teach them more like a web rather than discrete sets of knowledge.
• Verbal Example: How does this connect to what you've learned in the past? How can you use that knowledge today?
• Classroom Activity: Learning webs that connect content

Start with more complex math problems and scaffold as necessary.
• Verbal Example: If we wanted to build a rocket, what are all the things we might need to know before we get started? Along the way, we decided that we want the rocket to reach the moon. What do we need to consider now?
• Classroom Activity: When solving equations, start with the most complex problem, generate ideas for how to solve it, and use the simpler equations as examples to support those ideas.

Offer a variety of ways to demonstrate thinking and knowledge.
• Verbal Example: Show your thinking with words, pictures, symbols.

Ask other questions that will demonstrate learning when it is not clear to you how students know the answer.
• Verbal Example: If you were working with a fellow mathematician who was absent this day, what might you tell them to help them learn it?

Learn about, engage with, and incorporate ethnomathematics.
• Verbal Example: Reflect on your day so far. What math have you already used today?
• Classroom Activity: Community walks to engage with slope.

Co-construct knowledge in the classroom.
• Verbal Example: Let's get into partners and do a think pair-share. We will incorporate everyone's ideas and try to synthesize them.
• Classroom Activity: Have students create mathematical definitions in their own words in groups, and bring the groups together to co-construct mathematical definitions as a class

Choose problems that have complex, competing, or multiple answers.
• Verbal Example: Come up with at least two answers that might solve this problem.
• Classroom Activity: Challenge standardized test questions by getting the "right" answer, but justify other answers by unpacking the assumptions that are made in the problem.
• Classroom Activity: Deconstructed Multiple Choice
- given a set of multiple choice answers, students discuss why these answers may have been included (can also be used to highlight common mistakes).

Identify what is right about the thinking, and highlight the mistake in what is factually or procedurally accepted.
• Verbal Example: You recognized that you had to combine the constants 27 and 9, could you explain your thinking?
• Classroom Activity: Error Analysis worksheets that highlight what is the right idea behind the mistake.

Using thoughtful questioning to solicit mathematical thoughts rather than telling.

• Verbal Example: What would a mathematician who is confused ask about this question?

• Classroom Activity: After students demonstrate knowledge of a topic, have them play a game where they have to explain their topic to a fellow mathematician and a skeptic. Develop their own reflective questioning/explaining in all three roles.

Create multiple ways of participating that honor myriad ways of thinking and being.
• Verbal Example: For this section, feel free to work alone, in pairs, trios, or quads (let them choose).
• Classroom Activity: Community circles or storytelling circles, incorporating dance, music, song, call and response, and other cultural ways of communicating.

Climate Change

Math Climate Change Companion Guide

New Jersey Student Learning Standards: Content Area

MATH.9-12.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).
MATH.9-12.G.CO.A.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
MATH.9-12.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.
MATH.9-12.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.
MATH.9-12.G.SRT.A.1	Verify experimentally the properties of dilations given by a center and a scale factor:

Integration of Career Readiness, Life Literacies and Key Skills

TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Integration of Computer Science and Design Thinking

CS.9-12.8.1.12.AP.1	Design algorithms to solve computational problems using a combination of original and existing algorithms.
CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.

Interdisciplinary Connections: NJSLS for ELA, Social Studies, Science and/or Math

ELA.RI.MF.9–10.6	Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.
ELA.W.AW.9–10.1.E	Provide a concluding paragraph or section that supports the argument presented.
	Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

21st Century Life and Career

TECH.9.4.12.DC.8	Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
TECH.9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
TECH.9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
TECH.9.4.12.TL.4	Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).
	Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.
	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
	Network connectivity and computing capability extended to objects, sensors and everyday items not normally considered computers allows these devices to generate, exchange, and consume data with minimal human intervention. Technologies such as Artificial Intelligence (AI) and blockchain can help minimize the effect of climate change.