Analytic Geometry/Geometry

Analytic Geometry COMPREHENSIVE COURSE OVERVIEW

Geometry COMPREHENSIVE COURSE OVERVIEW

Sample Mathematics Learning Plan

Big Idea/ Topic

- Experiment with transformations in the plane and develop an understanding of congruence in terms of rigid motion.

Standard(s) Alignment

MGSE9-12.G.CO.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).

MGSE9-12.G.CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

MGSE9-12.G.CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

MGSE9-12.G.CO.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.

Diagnostic Assessment

When completing the diagnostic assessment task found at the link below, students will translate , reflect, and rotate a shape about the origin. The student will also compare transformations to determine if figures are congruent.

Analytic Geometry and Geometry Diagnostic Exemplar Tasks

This assessment task can be used to diagnose students' level of understanding of the big idea and standards addressed in this learning plan.

Instructional Design

Engage

- **Synchronous** – How Did They Make Ms. Pac-Man? By Robert Kaplinsky. This lesson provides a real-life context for transformations including rotations, reflections, and translations which are the foundation for understanding congruence and similarity. Rather than begin the lesson by defining the terms and identifying them in the game, the goal is to let students initially describe the movements in their own words and then guide them towards a mathematically precise definition.
- **Asynchronous** – Robert Kaplinsky's Ms. Pac-Man activity can be adapted to be presented in an asynchronous computer format. The guiding questions remain the same.
    - Video 1- https://www.youtube.com/watch?v=oxVI3mxuNYU
    - Video 2- https://www.youtube.com/watch?v=PD_gy5zOv30
    - Video 3- https://www.youtube.com/watch?v=I1Y2U9C18uI
    - Video 4- https://www.youtube.com/watch?v=cNxiv-KsEfE
- **Unplugged/ Offline** – Transformation Scavenger Hunt/Bingo: Create a Bingo card with the terms: Dilation, Rotation, Reflection, and Translation. Students can complete the card by taking pictures of transformations they find around their home. They could also cut out transformations from a magazine (or junk mail) and glue onto the Bingo card. They should explain to their caregiver why each item is an example of that transformation. Here's a Bingo card generator. This is a great strategy for supporting vocabulary development and can be modified in many ways.

Explore

- **Synchronous or Asynchronous:**
    - **Desmos Activity: Transformation Golf: Rigid Motion:** In this activity, students use their existing understanding of translations, reflections, and rotations to complete a round of transformation golf. For each challenge, their task is the same: Use one or more transformations to transform the pre-image onto the image. We recommend you solve the challenges yourself before assigning this activity. Teacher Guide.
    - **Desmos Activity: Reflections in the Coordinate Plane**: This activity will support the transition from a visual understanding of reflections to an algebraic understanding of reflections in the coordinate plane. Disclaimers: 1. It only deals with reflections with either the x-axis or the y-axis being the line of reflection. 2. This activity is designed to be done after the initial introduction and exploration of geometric reflections. There is a certain understanding of reflections assumed. (Pre-image and image will be congruent and equidistant from the line of reflection, etc.) Teacher Guide.

    - There are numerous ways students can use GeoGebra to explore transformations. Here are activities for exploring reflections, rotations, translations, and glide-reflections.

- **Unplugged/ Offline** – Print the resources for this activity for students to complete in groups or independently. All of the details can be found at this link: Logo Licenses.

Note: *As students explore rotations, be sure to talk about the center of rotation. In middle school, students likely only explored rotations about the origin. They should gain experience with more diverse rotations.*

Apply

- **Synchronous** or **Asynchronous** - Desmos activity: Des-Patterns: In this activity students will practice writing coordinate rules to transform figures to complete patterns. They'll end by designing their own pattern and using the math they've learned to extend a pattern designed by a classmate. Teacher Guide.
- **Unplugged/ Offline** - This activity is from OpenMiddle.com. Directions: Given triangle ABC with vertices (-8,2), (-2,2), and (-2, 8), create triangle DEF in quadrant one that uses a translation, rotation, and reflection (in any order) to take that triangle to triangle ABC and show congruence.

Reflect

- **Synchronous** – Students are provided access to watch this video. Instructions: Write your own song (or poem, or brochure) explaining how to perform transformations (translation, reflection, rotation, dilation). Students could choose from a variety of ways to present their reflections: Garage Band to create song beats and melodies, Voice Thread (click this guide), or even FlipGrid (click this guide) to record the song and share it with the class.
- **Asynchronous** – Students are provided access to watch this video. Instructions: Write your own song (or poem, or brochure) explaining how to perform transformations (translation, reflection, rotation, dilation). Alternatively, the student can watch this video and use the lyrics of the song and create a *"remix"* to the song, spicing it up to the genre of their choice, using an app such as GarageBand or use custom beats/chords/melodies they create.
- **Unplugged/ Offline** – Let's get creative! Students write a song, poem, or riddle, to help explain how to perform translations, rotations, and reflections.

Students could choose from a variety of ways to present their reflections: Garage Band to create song beats and melodies, Voice Thread, or even Loom to record the song and share it with the class.

Evidence of Student Success

Three formative assessments are suggested for during the learning process. The first occurs during the Engage portion of the lesson which provides insight on students' understandings and misunderstandings. The second formative assessment occurs during the Apply portion of the lesson

when conducted synchronously or asynchronously. The final formative assessment should be collected to inform future instruction.

Synchronously, Asynchronously, or Offline. Ms. Pac-Man Challenges. In this activity, students are provided a screenshot of Mrs. Pac Man's starting and ending positions and must describe the transformations needed to get from beginning to end. There are a variety of ways this assessment can be facilitated! Ideas: Randomly assign cards to different students. Have them present their explanations using FlipGrid or another threaded discussion platform.

Offline assessment:

In this paper assessment, students will perform and describe various transformations.

Student Learning Supports and Support Class Suggestions

At all grades, the mathematics big ideas encourage students to reason mathematically, to evaluate mathematical arguments both formally and informally, to use the language of mathematics to communicate ideas and information precisely, and to make connections among mathematical topics and to other disciplines. The following strategies are intended to support students who are struggling to progress towards this goal:

- ***Conceptual Processing:*** Utilize the Concrete-Representational-Abstract instructional sequence to support students in making connections among mathematical ideas, facts and skills, and reflecting upon and refining one's own understanding of relationships, generalizations and connections.
- ***Language:*** Strategically select language routines to support students in describing strategies, explaining their reasoning, justifying solutions and making persuasive arguments.
- ***Visual-Spatial Processing:*** Provide opportunities for students to engage with visual representations and manipulatives (virtual or concrete) as they solve problems, explore concepts and communicate ideas.
- ***Organization:*** Teach problem-solving strategies and problem types, as seen in the Mathematics Glossary: K – 12, in order to support students in figuring out how to get started, carrying out a meaningful sequence of steps while solving problems, keeping track of the information from prior steps, monitoring their own progress and adjusting strategies accordingly.
- ***Memory:*** Focus on conceptual strategies and patterns for computation, providing a scaffold for students who struggle with basic facts and carrying out written algorithms.
- Additional practice activity: Shape Mods game: Students flip, turn, and slide their way through 18 mind-boggling puzzles.
- Additional engagement activity: Desmos activity: Connecting the Dots. In this lesson, students focus on communicating precisely about transformations of polygons on the coordinate grid. They must think carefully about what information is needed to describe a transformation in a

clear, precise way. The coordinate grid plays a key role in this work, allowing students to effectively communicate the locations of polygons and how they are transformed. Teacher Guide.

- Additional engage or explore or reflection activity: Tiling with Triangles (synchronous or asynchronous virtual manipulative). Students create their own tessellations and can write about the transformations they perform.
- Hitting a Target ((synchronous or asynchronous virtual manipulative). Students explore compositions of functions.
- Transformation Scavenger Hunt/Bingo: Create a Bingo card with the terms: Dilation, Rotation, Reflection, and Translation. Students can complete the card by taking pictures of transformations they find around their home. They could also cut out transformations from a magazine (or junk mail) and glue onto the Bingo card. They should explain to their caregiver/teacher why each item is an example of that transformation. Here's a Bingo card generator. This is a great activity for supporting vocabulary development.
- Additional reflection activity: Ticket out the Door: 3-2-1: Three things you learned in this lesson, two things you want to know more about, and one thing you're confused about.
    - In-person or offline: Students can write their answers on a sticky note or in their math journals.
    - Online: Students could share their responses on a shared document or an online bulletin board such as linoit.com.
- Additional reflection activity: Provide the logos on the Copy Master (projected on a large screen, via PowerPoint presentation, or sent home in a packet). Ask the students to each write down what symmetry each design has. Get them to share what they have written in pairs then bring the class together for a collective discussion.

Engaging Families

- Here are some videos that families might benefit from watching together to review terminology related to transformations.
    - Translations Explained video
    - Reflections Explained video
    - Rotations Explained video
    - Dilations Explained video
- Provide the logos on the Copy Master (projected on a large screen, via PowerPoint presentation, or sent home in a packet). Ask each family member to each write down what symmetry each design has.
    - For each logo, get students to demonstrate what symmetry the design has by using scissors or folding and flipping, rotating. Make a list of symmetries for each design.
    - Compare the new list to the initial lists that family members did individually. Work together to create one comprehensive list of all the symmetries present for each design.
- Transformation Scavenger Hunt/Bingo: Create a Bingo card with the terms: Dilation, Rotation, Reflection, and Translation. Students can complete the card by taking pictures of transformations they find around their home. They could also cut out transformations from a magazine (or junk mail) and glue onto the Bingo card. They should explain to their caregiver why each item is an example of that transformation. Here's a Bingo card generator. This is a great activity for supporting vocabulary development.