High School Geometry
Transformations

This learning progression covers Transformations and is designed for a high school Geometry class that will mainly consist of 9th and 10th graders. The Common Core State Standard that this learning progression will meet is HSG.CO.A.5. The Mathematical practices that this progression will meet are MP1, MP5, and MP6.

The textbook they will be using in this class is McDougal Littell Geometry by Larson, Boswell, and Stiff. The sections from the textbook that we will be using during this progression that align with the CCSS standards are 7.1 Rigid Motion in a Plane, 7.2 Reflections, and 7.3 Rotations. The students have previously been learning about the properties of lines and shapes along with a basic understanding of transformations. This progression will expand on these concepts while focusing on lines and shapes as they are transformed in the plane. The central focus of this learning progression is understanding what the three transformations are and how to find coordinates in the plane when applying a transformation to the line or shape.

We will start the learning progression by introducing the chapter of Transformations and briefly talking about each of the transformations we will be covering just so that students know what to expect. We will then be going over notes, definitions, and example problems for the first section, 7.1 Rigid Motion in a Plane. I will do example problems, with students following along so they can see the steps and processes taken, and then give them another similar problem to try on their own before going over it as a class. They will have problems to work on for the remainder of the class period either on their own or with a peer to get more practice with the concepts. By focusing on definitions, notes, and practicing examples on this first lesson while also having time to work with other peers, students will

Common Core State Standards

Content Standards

CCSS.MATH.CONTENT.HSG.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.

Mathematical Practices

CCSS.MATH.PRACTICE.MP1
Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP5
Use appropriate tools strategically.

CCSS.MATH.PRACTICE.MP6
Attend to precision.

have plenty of time to get a good understanding of these concepts. Grouping higher-achieving students with lower-achieving students is beneficial for both students since they get to discuss their ideas and teach each other, so this would be especially beneficial for a student with an IEP or a 504 plan, because they may be struggling with the concepts. By placing them with a student who is proficient with the concepts, it could help them gain a better understanding.

On the following day, we will start out with an entry task, see benchmark assessment 1 and 2. These benchmark assessments will help students to briefly review the material learned yesterday before starting on the next lesson. After completing the entry task, we will go over the solutions as a class so that students can immediately see what they got right and what they got wrong on the entry task so that they can correct those mistakes easily. We will review the steps for finding an image from a preimage before going onto the next lesson to make sure they have these steps down. We will then start the notes for 7.2 Reflections. I will start by asking the students about reflections and talking about how reflections work when using a mirror, so that students can relate to the concept of reflections. I will then give students vocabulary words, definitions, and example problems. We will be doing an activity for the majority of the period, where students can choose to work on it individually, or in small groups of no more than 3-4 people. They will be given a packet of problems where they will be finding lines of symmetries of shapes, and reflecting shapes on coordinate planes. I will be grouping students myself instead of letting them pick their groups to ensure that students of all different achievement levels are mixed into each group so that they can all help each other learn and better understand the concepts. By doing this it keeps any one group from having all students who are very comfortable with the

Benchmark Assessment 1:

A transformation and a preimage point are given. Find the image point.

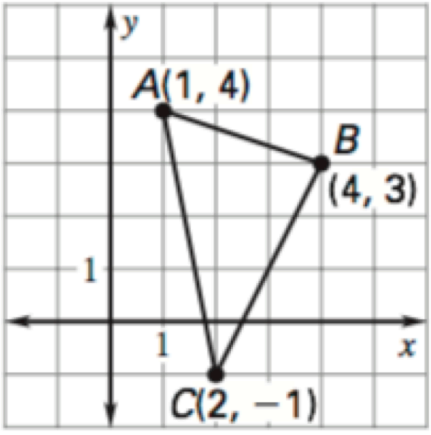
Preimage: (5, -4)

Transformation: (x,y) → (8-x, y+3)

Benchmark Assessment 2:

Sketch the image of the given triangle after the given transformation. Give the coordinates of the image. Based on your graph, identify the transformation as a reflection, rotation, translastion, or other transformation, and tell whether the transformation appears to be an isometry.

Transformation: (x,y) → (x+4, y-3)



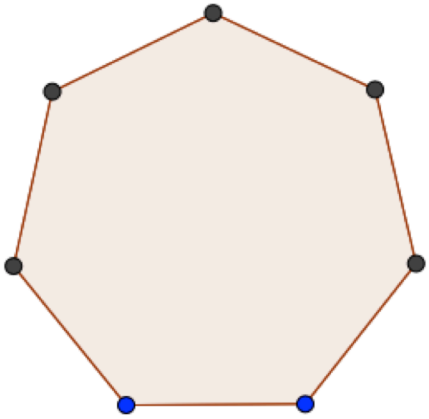
concepts, and then having a group with all students who are struggling and unable to help each other. I will be walking around the room looking over their work to check understanding. If I notice any problems that students are consistently struggling with, I will leave time at the end of the period to go over these problems as a class so any misconceptions can be fixed before the students leave class for the day.

The third day of this learning progression, students will start off the period with an entry task, with a problem finding lines of symmetries and another problem where students have to reflect the shape in the coordinate plane as a review for the previous day. See benchmark assessments 3 and 4. These assessments will help them to review the concept of reflections from the previous day. For this lesson, we will be covering section 7.3 Rotations from the textbook. I will start the lesson by having students discuss with their peers different examples of rotations in the real world for a couple minutes and then we will come back together as a class so that we can discuss some of the ideas students came up with. I will then go over definitions, vocabulary words, and examples with the students. I will have them follow along on the examples and then try some on their own. They will have a homework assignment with practice problems that they will have the opportunity to work on for the remainder of the period. Students can choose to work individually on the assignment, or with another peer so that they can discuss their answers. I will collect students' homework assignments the following day to check for their understanding.

On the final day of this learning progression, students will start out with an entry task with a problem where students have to determine if a shape has rotational symmetry, and another problem where the students have to determine if a given shape is a the preimage of another shape after a 90 degree rotation. See benchmark assessments 5 and

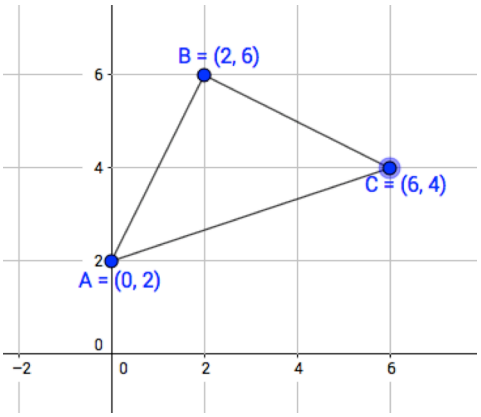
Benchmark Assessment 3:

Draw all the lines of symmetry on the given shape and state how many there are.



Benchmark Assessment 4:

Reflect this preimage over the x-axis and graph the image.



6. After completing the entry task, we will discuss the correct answers as a class. We will then start reviewing the three concepts we worked on in the first three lessons of this learning progression. By this time, I will have all the assignments graded from the last three lessons, so I will go over the most missed problems from each assignment so that students can see the correct steps and answers. I will also review what each concept does to a shape on the coordinate plane before going on to the activity. Students will be working in groups that I assign, by grouping high-achieving students with lower-achieving students, so that they can all gain a better understanding of the concepts. Each group will start at a station and complete the problems as a group, and after 5 or so minutes, groups will rotate to the next station. Each station will focus on a different type of problem that we have covered over the last three lessons. For example, one station will have multiple questions where they have to determine how many lines of symmetry there are for each given shape (similar to benchmark 3), and another station will have problems where they have to graph the rotation of a given shape along with having to determine if a shape is the image of another shape after a rotation. After completing all of the stations, I will have one student from each group come up and write the solution to one of the questions from their starting station. By doing this, students can compare their work and see what was done correctly and what needs to be fixed in the solution. The next day, students will get an entry task with some problems involving the more challenging concepts so that they can get a little more review before continuing on in the chapter.

Benchmark Assessment 5:

Determine whether the rectangle has rotational symmetry. If so, describe the rotations that map the rectangle onto itself.

Benchmark Assessment 6:

Determine if $\Delta A'B'C'$ is the image of ΔABC after a 90° clockwise rotation.