

High School Geometry

Transformations

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This learning progression will be taught in a sophomore level Geometry course at Ellensburg High School. The Common Core State Standard (CCSS) domain and cluster for this learning progression is: CCSS.MATH.CONTENT.HSG.CO.A. There are two standards that the students will be learning: HSG.CO.A.1 and HSG.CO.A.2, and HSG.CO.A.4. The math practices (MP) that will be used by students during this progression will be MP1, MP3, and MP5.

The textbook used in the class is McDougall Littell's Geometry 10th edition. In teaching this learning progressions, we assume that students have a basic understanding of the Cartesian Plane. Students should also be able to describe what a point and line on the Cartesian Plane look like. The CCSS associated with graphing is MATH.CONTENT.5.G.A.1.

This learning progression will be broken into three separate lessons. The first lesson will cover HSG.CO.A.1 and HSG.CO.A.2. The second lesson will cover HSG.CO.A.4, but it will specifically address rotations and translations. The third lesson will also cover HSG.CO.A.4, but it will focus on reflections.

For lesson one, students will be showing proficiency for HSG.CO.A.1 and HSG.CO.A.2. The students will begin with a review of what a coordinate plane is. This will be reviewing 5.G.A.1. The learning target for this lesson will be "I can identify objects in a coordinate plane." Students will be asked to turn to think-pair-share on how we set up a coordinate plane and what each element of the plane is called, e.g., x-axis, y-axis, quadrants I-IV, etc. Students will be given one minute to think, one minute to pair, and then we will share for approximately one minute. Once students have shared, the teacher will show a worksheet with a set of parallel lines and a set of perpendicular lines. There will also be a line and a line segment. The teacher will then ask if any students can give the correct vocabulary for

CCSS.MATH.CONTENT.HSG.CO.A

Experiment with transformations in the plane

HSG.CO.A.1

Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

HSG.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).

HSG.CO.A.4

Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

CCSS.MATH.PRACTICE.MP1

Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP3

Construct viable arguments and critique the reasoning of others.

the given items. After students have defined these terms, the instructor will fill in any gaps. This will address HSG.CO.A.1. Next the teacher will show a line segment on a graph. The instructor will then ask what ways he could move the object. The teacher will be looking for the idea of moving a point. The teacher will ask what would happen if one point of the line segment was moved and the other stayed in place. The students should come up with the concept of stretching. The teacher will give students the definition of translation, which is when we move an object or point in a coordinate plane, as well as preimage and image. The teacher will then ask what if we moved both points. The answer would be that the line segment would remain the same length. The teacher will then introduce the vocabulary word isometry, which is a transformation in the plane which preserves length, angle measure, parallel lines, and distance. This will address HSG.CO.A.2. The teacher will then assign homework from page 399 problems 1-16, 21-31, 34, and 35. All of these problems correlate to the previously taught materials.

Lesson 2 will begin when the instructor will review that transformations change points and objects in the plane. The learning target for this lesson will be “I can translate and rotate objects in the plane.” The instructor will then ask the students to share ideas of how they think we could transform an object on the plane. The instructor will then use the document camera to show a Cartesian Plane. On this plane will be three points: (2,2), (-2,3), and (-4,-1), which create a triangle. The teacher will give approximately 10 seconds for students to answer, if not the instructor will begin describing some of the transformations that can be performed, specifically rotation, reflection, and translation. The instructor will use the concept of translation to show how an object is moved on the plane. This will address part of HSG.CO.A.4 that covers translations. The teacher will ask students what the name of each image created on the plane, the correct answer being preimage and image. The instructor will then ask the students if they could describe what the preimage would look like if they rotated the triangle 90 degrees. Once students have been given the opportunity to

CCSS.MATH.PRACTICE.MP5

Use appropriate tools strategically.

5.G.A.1

Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).

answer, the instructor will take a cutout of the same size and place it over the preimage. The instructor will then rotate the image 90 degrees to show what happens. This will address HSG.CO.A.4 for rotations. The instructor will hand out a worksheet with several problems pertaining to rotations and reflections. Students will be able to work in groups, but may also work individually. The instructor will walk the classroom to ensure that students are working as well as answering any questions that may arise. The teacher will ask students a hinge question based on the worksheet to check for student understanding.

For Lesson 3, the instructor will begin with a lesson outline sheet on the document camera. The learning target will be presented to the students; “I can identify reflections and use them to find coordinates.” The students will be asked to come up with a definition for the word reflection. After attempts by the students, the teacher will give the simple definition that it makes a mirror image. The teacher will then define the line of reflection for the students. The instructor will ask the students to define isometry as a review question as well as what isometry transformations preserve. The instructor will then have students graph three given reflections on their own. After students have had time to graph the reflections, the teacher will ask for the image coordinates and write them on the document camera as well as graph them. This will address HSG.CO.A.4 for reflections. The teacher will then ask if students can define what a line of symmetry is. After students volunteer answers, the teacher will give the exact definition. For the next example, three figures are given to the students. The students need to think-pair-share about what the lines of symmetry for the objects are. After time has been given for thinking, students will pair with their partners to compare, and then they will volunteer to share with the class. For the final example, two pairs of possible reflections are given to students. They are to determine which pair is a reflection and which is not. The instructor will ask for a volunteer to share their answer. Then the instructor will hand out a rich math task worksheet that has to do with a real world problem involving power lines and the shortest distance between two points using a reflection. Students will be allowed to work together to complete the worksheet. After the worksheet has been completed students will be assigned homework from the book based on the previous two lessons. An exit slip will be handed out for students to self-assess their learning of the day’s lesson.