High School: Geometry

Proportion and Similarity

This learning progression is intended for a 10th grade geometry class. The curriculum will be taught from the textbook, "Geometry" by Houghton Mifflin Harcourt. The lessons will focus on solving ratios and proportions and how to use them when determining whether two figures are similar. The CCSS-Math Clusters used are *Write Expressions In Equivalent Forms to Solve Problems,* which the standard HSA.SSE.B.3 comes from, and *Understand Similarity In Terms of Similarity Transformations,* which the standards HSG.SRT.A.2 and HSG.SRT.A.3 come from. The Standards for Mathematical Processes used for the duration of this learning progression are MP1, MP6, and MP7.

For this learning progression the central focus is that students will be able to write and solve for ratios and proportions. They will also be able to use that information to determine if two figures are similar. The purpose of this progression is to support student's understanding of ratios and proportionality in relation to similar figures. The learning targets are: I can use ratios to solve problems, I will be able to determine if 2 polygons are similar, and I will be able to prove that 2 triangles are similar. These will help students understand how to solve ratios and use them to determine proportionality. With their previous knowledge of fractions and properties of polygons and triangles they will have the opportunity to demonstrate using the ratios and proportions of polygons and triangles to determine if they are similar figures. The process of solving problems using ratios, verifying if parts of given figures are

proportionate, and determining if figures are similar will require problem-solving skills and help them develop mathematical reasoning.

This learning segment is heavily related to previous knowledge of rational numbers and the lessons that follow build on one another. The students will work in pairs or small groups during the lessons, in which students with dissimilar academic or language needs are placed together. According to "Flexible Grouping as a Differentiated Instruction Strategy" by Janelle Cox, grouping students (flexible grouping) is a great strategy to help students reach the goals, or learning targets, by taking into account each students' individual needs. Students that struggle in mathematics and EL students will have the opportunity to learn from their peers in a comfortable and contributing way.

Formative assessment in the form of observation and discussion will be the primary procedure to support student learning. As the students complete the tasks with their partners I will observe how they are finding solutions and ask them questions about their understanding. I will ask, "How did you find the ratio and what is the proportion?" and "Explain why the two polygons are similar." While they are working on the last lesson I will ask, "Which similarity theorems (AA, ASA, and SSS) will you use to prove that the triangles are in fact similar?" Through observation, the students' communication with one another and their effort to solve the problems will support their learning. Through discussion I will be able understand how well they understand the concepts in relation to the CCSS.

For the first task students will receive a worksheet with computations for ratios and

LESSON 1

<u>Learning Target</u>

I can use ratios to solve problems.

<u>Question Examples</u>

1. Write each ratio as a fraction in lowest terms.
    a. $6 : 18$
    b. $18/12$
    c. 24 to 96
2. Solve each proportion and give the answer in simplest form.
    a. $6 : 8 = n : 12$
    b. $\frac{2}{7} = \frac{8}{n}$
    c. $2\frac{1}{2} : 3\frac{1}{2} = n : 2$
3. One store has 360 items and another store has 100 of the same items, express the ratio of the items.
4. You earn \$350 a week. Your take-home pay, however, is \$295. What is the ratio of your gross pay to your take-home pay?
5. The perimeter of a triangle is 72 inches, and the ratio of the measures of the sides is 3:4:5. Find the measure of the sides.

<u>Hinge Question</u>

What is the relationship between a ratio and a proportion?

proportions as well as real world problems. They will work with a partner or group of three to complete the task. They will begin by solving ratios and putting them into lowest terms. Then they will use the ratios and set them equal to one another to solve the proportion. This will require them to find the cross products of the ratios and solve for the missing variable. The last part is a series of real world word problems, where the ratio and proportions need to be found based on the information given. The students will have to express the proper ratios and/or create the correct equations to solve these types of word problems. This is related to their previous knowledge of fractions and percentages and the mathematics standard HSA.SSE.B.3. While completing this task the students will be working toward mathematical practices MP1 and MP6. MP1 will be demonstrated when they are reducing ratios. When students are using the cross product to solve proportions they will be working toward MP1 and MP6.

The second task will require the use of ratios, learned in the previous lesson, congruent angles, and corresponding sides to identify similarities in polygons. The students will begin with a warm up that has triangles of different sizes in which they must identify pairs of congruent sides and angles. They will be given a handout and use their previous knowledge of congruence (angles and sides) and ratios to identify similarities between polygons. When students are able to find congruent angles and corresponding sides of a polygon then they will be able to find the similarity ratio. They will be able to recognize if the ratios of the angles and sides are proportional. This similarity ratio will help them determine if polygons are similar. They will use procedural fluency and
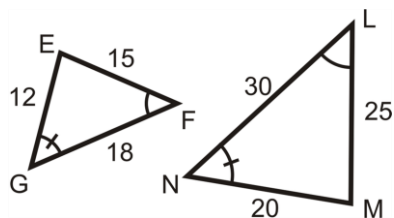
LESSON 2

Learning Target

I will be able to determine if 2 polygons are similar using ratio and proportions.

Question Examples

1.) Identify the pairs of congruent angles and corresponding sides.

2.) Next, determine whether the polygons are similar, if so, what is the similarity ratio?

Hinge Question

How do you use the ratio for the sides of a polygon to determine if they are similar?

mathematical reasoning to relate information learned from the previous lesson with previous and newly learned concepts to find similar polygons using ratios. This task is aligned with the mathematics standard HSG.SRT.A.2 and the mathematical practices MP6 and MP7. Students will demonstrate MP6 when they identify congruent angles and corresponding sides. They will demonstrate MP7 when finding the similarity ratio.

The third task will be a combination of partner/small group work on whiteboards and a small worksheet that shows the student's ability to prove triangle similarity. They will use the triangle similarity theorems, AA, SSS, and SAS, to show how congruent angles and corresponding sides that are proportional determine if triangles are similar (MP7). This is connected to the mathematical standard HSG.SRT.A.3, where students must use AA to determine that two triangles are similar. While working with their peers on whiteboards they will be given examples of pairs of triangles that they must draw and label the similar properties (congruent angles and proportion of corresponding sides). Students will use problem solving skills along with information they learned in previous lessons to solve these problems (MP1). After working together to understand the concepts introduced in this lesson, students will be given a short handout. This worksheet will show what they understand throughout the entire learning progression, since the lessons are closely related and build on each other. It will have pairs of triangles where all learning targets within this learning progression will be met. They will need to determine ratios and proportions of sides and congruent angles (MP6) of the triangles to prove the similarity theorems.
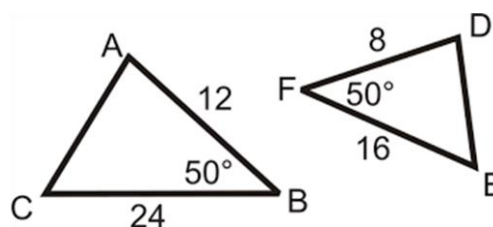
LESSON 3

Learning Target

I will be able to prove that triangles are similar by using AA, SSS, and SAS.
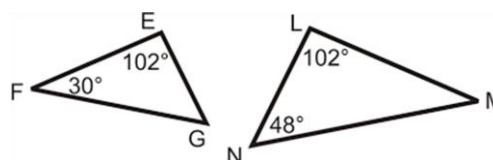
Question Examples

Explain how the given sets of triangles are similar.

1.

2.

Hinge Question

How does the triangle similarity theorems differ from the triangle congruence theorems?