Grade: Math 2 Lesson Title: Using Similarity in Proofs

Unit 6: Similarities and Volume (Lesson 2 of 3) **Essential Question:**

Time Frame: 1-2 weeks

- In terms of similarity transformations, when are two geometric figures similar?
- What are the necessary conditions to know when two triangles are similar?
- What are the sufficient conditions to know that two triangles are similar?
- How can the geometric relationships that come from proving triangles congruent or similar be applied in problems solving situations?

Targeted Content Standard(s):	Student Friendly Learning Targets
G.SRT.3 Use the properties of similarity transformations to establish the	I can
AA criterion for two triangles to be similar	 Use similarity transformations to verify AA similarity
G.SRT.4 Prove theorems about triangles. Theorems include: a line	• Use criteria for proving two triangles
parallel to one side of a triangles divides the other two proportionally,	to be similar (AA, SAS, SSS for
and conversely; the Pythagorean Theorem proved using triangle	similarity)
similarity.	Use similarity to prove theorems
	about triangles including:
Targeted Mathematical Practice(s):	 Side-Splitter Theorem
1 Make sense of problems and persevere in solving them	
🔀 2 Reason abstractly and quantitatively	
3 Construct viable arguments and critique the reasoning of others	
4 Model with mathematics	
5 Use appropriate tools strategically	
6 Attend to precision	
7 Look for and make use of structure	
8 Look for an express regularity in repeated reasoning	
Supporting Content Standard(s): (optional)	

Purpose of the Lesson:

The purpose of this lesson is to establish student understanding of similarity using various methods. This lesson includes explorations of similarity via transformations and the Pythagorean Theorem. Students will also verify criteria for triangle similarity, including AA, SAS, and SSS.

Explanation of Rigor: (Fill in those that are appropriate.)			
Conceptual: Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	Procedural:	Application: Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.	
Vocabulary:			

Criteria for triangle similarity

- AA similarity
- SSS similarity
- SAS similarity

Side-splitter theorem

Pythagorean theorem (triangle similarity)

Evidence of Learning (Assessment):

Pre-Assessment:

Formative Assessment(s): Using Similarity Criteria (Segment 2), Side-splitter theorem (Segment 3), Varignon Quadrilateral (Segment 4)

Summative Assessment: Using Similarity Criteria (Segment 2)

Self-Assessment: Are they Similar? (Segment 1)

Lesson Segments:

- 1. Use the properties of similarity transformations to establish the three criteria for two triangles to be similar.
- 2. Using the criteria for triangle similarity (AA, SSS, SAS) to determine if two triangles are similar
- 3. Prove that a line parallel to one side of a triangle will divide the other sides proportionally (and its converse).
- 4. Prove that the quadrilateral formed by connecting the midpoints of consecutive sides of a quadrilateral (called the Varignon quadrilateral) is a parallelogram and will explore which quadrilaterals have specific Varignon quadrilaterals

Lesson Procedures:			
Segment 1			
Approximate Time Frame: 90-120 minutes	Lesson Format: Whole Group Small Group Independent Modeled Guided Collaborative Assessment		Resources: Are They Similar? assessment Grid paper (dynamic geometry software can also be used)
Focus: Use the properties of similarity transformations to establish the three criteria for two triangles to be similar.			Modalities Represented: Concrete/Manipulative Picture/Graph Table/Chart Symbolic Oral/Written Language Real-Life Situation
Math Practice Look For(s):		Differenti	iation for Remediation:
 #2 Reason abstractly and quantitatively. Students will be able to use figures and information pertaining to a specific geometric object as an aid in reasoning about that geometric object in general. #3 Construct viable arguments and critique the reasoning of others. Students will be able to create and present proofs, and be able to critique the proofs and deductive reasoning of others. 		Differentiation for English Language Learners: Differentiation for Enrichment:	
Potential Pitfall(s):		Independent Practice (Homework):	
May not understand/remember angle of	congruence		
Difficulty calculating ratios			Т
Steps:			Teacher Notes/Reflections:
1. Review <i>similarity</i>			
a. What is sufficient to prove that two figures are similar?		are	
b. How do dilations play a part in two figures being similar?		eing	
2. Students will be divided into groups of 2-3			
a. Hand out Are They Similar? Assessment.			
 Explain that each student must complete the constructions (grid paper or dynamic geometry software). 		e itry	
c. Each group will fill out one activity.			
d. Instruct students to work through each investigation.			

3.	As groups finish, pair them up with other groups to share and discuss their findings. Have them make note of any discrepancies to later share with the whole class.	Teacher Notes/Reflections:
4.	Hold class discussion to summarize findings and discuss use of the triangle similarity criteria in a formal proof. Also discuss that AA similarity can be discovered by dilating a triangle with respect to a vertex of that triangle.	

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Segment 2				
Approximate Time Frame: 45 minutes	Lesson Format: Whole Group Small Group Independent			Resources: Using Similarity Criteria assessment
Focus: Using the criteria for triangle similarity (AA, SSS, SAS) to determine if two triangles are similar	 Modeled Guided Collaborative Assessment 			Modalities Represented: Concrete/Manipulative Picture/Graph Table/Chart Symbolic Oral/Written Language Real-Life Situation
Math Practice Look For(s): #1 Make sense of problems and persevere in solving them. Students will find missing measures in triangles given that two triangles are similar		Differentiation for Remediation: Differentiation for English Language Learners: Differentiation for Enrichment:		
 #2 Reason abstractly and quantitatively. Students will be able to use figures and information pertaining to a specific geometric object as an aid in reasoning about that geometric object in general. #4 Model with mathematics. Students will be able to solve a variety of problems that either involve or can be modeled with triangles by applying the properties of congruent and of similar triangles. 				
Potential Pitfall(s):		Independent Practice (Homework):		
Steps: 1. Discuss the criteria discovered during the <i>Are They Similar</i> activity and how they can be used to identify similar triangles. a. Some example problems may be completed as a class i. Here is one possible example: Determine if the two triangles are similar $ \int_{\overline{E}} \frac{\overline{AD} = 5}{E = 4.0} \int_{\overline{E}} \frac{1}{E = 2.05} \int_{\overline{E}} \frac{1}{E = 5.15} \int_{\overline{E}} \frac{1}{E = 6} \int_{\overline{E}} \frac$		ar ngles. class r	Teacher N	otes/Reflections:



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Segment 3				
Approximate Time Frame: 90 minutes	Lesson Format: Whole Group Small Group Independent			Resources: Side-Splitter Theorem assessment
Focus: Students will prove that a line parallel to one side of a triangle will divide the other sides proportionally (and its converse).	 Modeled Guided Collaborative Assessment 		-	Modalities Represented: Concrete/Manipulative Picture/Graph Table/Chart Symbolic Oral/Written Language Real-Life Situation
 Math Practice Look For(s): #2 Reason abstractly and quantitatively able to use figures and information pertigeometric object as an aid in reasoning a geometric object in general. #3 Construct viable arguments and critic of others. Students will be able to create proofs, and be able to critique the proof reasoning of others. #4 Model with mathematics. Students solve a variety of problems that either in modeled with triangles by applying the proof congruent and of similar triangles. 	y. Students will be taining to a specific about that ique the reasoning e and present fs and deductive will be able to hvolve or can be properties of	Differe Differe	entiation for F entiation for E entiation for E	Remediation: English Language Learners: Enrichment:
Potential Pitfall(s):		Indepe	endent Practio	ce (Homework):
 Steps: Hand out Side-Splitter assessment. Complete exercises 1 and 2 as a whole group. Facilitate discussion to informally assess student understanding du this process. Direct students to work in pairs to complete exercise 3. 		Iring	Feacher Note	s/Reflections:
4. Discuss exercise 3 as a group and how knowing propertie dilation makes the proof more concise.		es of		

5.	Complete examples of using the theorems to solve for a missing part of a triangle. Then, assign students to work individually on the remainder of the assessment. Monitor student successes.	Teacher Notes/Reflections:

Segment 4	I		
Approximate Time Frame: 60-90 minutes	Lesson Format: Whole Group Small Group Independent		Resources: <i>Varignon Quadrilateral</i> assessment
Focus: Students will prove that the quadrilateral formed by connecting the midpoints of consecutive sides of a quadrilateral (called the Varignon quadrilateral) is a parallelogram and will explore which quadrilaterals have specific Varignon quadrilaterals.	 Modeled ⊠ Guided ⊠ Collaborative ⊠ Assessment 		Modalities Represented: Concrete/Manipulative Picture/Graph Table/Chart Symbolic Oral/Written Language Real-Life Situation
Math Practice Look For(s): #1 Make sense of problems and persevere in solving them. Students will recognize the hypothesis and conclusion in a proof statement and be able to generate the requisite proof using the given information in the proof statement, along with known facts, definitions, postulates, and theorems.		Differentiation fo Differentiation fo Differentiation fo	or Remediation: or English Language Learners: or Enrichment:
#2 Reason abstractly and quantitatively able to use figures and information pert geometric object as an aid in reasoning object in general.	 y. Students will be aining to a specific about that geometric 		
#3 Construct viable arguments and critic of others. Students will be able to creat and be able to critique the proofs and d of others.	ique the reasoning e and present proofs, eductive reasoning		
#6 Attend to precision. Students will recognize that incorrect initial attempts at definitions, conjectures, and theorems may be corrected through a process of refinement.			
#7 Look for and make use of structure. able to use the structure of geometric o insights into, make conjectures about, a pertaining to these objects.	Students will be bjects to gain nd create proofs		
Potential Pitfall(s):		Independent Pra	ctice (Homework):
Students may not recognize that a segme midpoints of two sides of a triangle divid proportionally (with ratio being 1:1), wh order to apply the converse of the Side- complete this proof. Similarly, students Midsegment Theorem, which can also b complete this proof.	nent connecting the de those two sides nich is necessary in Splitter Theorem to may not recall the ne applied to	After being starte the assessment w properties that a have a specific ty left as homework	ed in class, the exploration portion of where students conjecture about the quadrilateral must have in order to pe of Varignon Quadrilateral could be

Ste	ps:	Teacher Notes/Reflections:
1.	Hand out Varignon Quadrilateral Assessment.	
2.	Sketch a quadrilateral and its Varignon Quadrilateral, preferably using a dynamic geometry software so that it is easy to show students examples of Varignon Quadrilaterals for various different types of quadrilaterals.	
3.	Sketch a diagonal of the original quadrilateral in your figure. Point how this diagonal divides the quadrilateral into two triangles where two sides of the Varignon Quadrilateral "split" the sides of these two triangles.	
	This would be a good time to remind students of the Side- Splitter Theorem (or the Midsegment Theorem) and ask them how it might be applied to this problem.	
4.	Facilitate/guide students to an answer to question #3.	
5.	Once question #3 is answered correctly, facilitate students group work through questions #4-#11	
6.	Start students on exploration problems by asking them what would have to be true about a quadrilateral if its Varignon Quadrilateral is to be a rectangle.	
7.	Facilitate student group work in completing explorations.	
8.	Have students complete explorations either in class (time permitting) or as homework.	
9.	Discuss answers to exploration questions.	
	As the exploration solutions are discussed, you may wish to questions students to get them to consider other possibilities, if students have not generalized their answers sufficiently (e.g., only considered parallelograms rather than general quadrilateral when considering solutions).	