Plan for Geometry Unit 3: Congruence

Relevant Unit(s) to review: Grade 8 Unit 2: Dilations, Similarity, and Introducing Slopes [Lessons 6-9]
Grade 8 Unit 8: Pythagorean Theorem and Irrational Numbers [Lessons 6-8]

Essential prior concepts to engage with this unit	This unit is accessible due to its visual and kinesthetic approach. Students will review in context many concepts first introduced in grades 6–8 and in prior units in this course. Concepts such as proportional reasoning, scale factor, rigid transformations, and dilations. Access to tracing paper and colored pencils is helpful to support. Two key understandings will need to be addressed as the need arises: ● strategies for working with proportional relationships (making tables, diagrams, using concept of equivalent ratios, and equations in the form of $y = kx$, where k is the scale factor) ● Fluently solve for unknown side lengths in right triangles.
Brief narrative of approach	This unit begins with a focus on using rigid transformations and dilations to prove triangles are similar. Building from this preliminary work, students develop similarity shortcuts and prove the Angle-Angle Triangle Similarity Theorem. Students then use these ideas to justify that two triangles are similar, as well as to find unknown side lengths using the fact that side lengths in similar figures are in the same proportion. This guide made little adjustments to the first part of the unit, as students are building from experiences in previous units, as well as units early in grade 8. However, we recognize the later part of grade 8 was interrupted and may have impacted work with the Pythagorean Theorem. For this reason, you will see additional pieces to bridge grade 8 expectations into high school.

<table>
<tr><th>Lessons to Add</th><th>Lessons to Remove or Modify</th></tr>
<tr><td>For this unit, most students will have completed the prerequisite lessons in Grade 8 Unit 2 and Grade 8 Unit 8 Some of the lessons listed might make a nice reference to activate prior knowledge.

1. 8.2.5.1 “Many Dilations of a Triangle”: digital applet where students can manipulate and observe the dilation of a triangle to see how the size of the factor impacts the dilation of the image. Recommend use after Lesson 3.
2. 8.2.6.4 “Methods for Translations and Dilations”: gives students a structured opportunity to practice showing that two shapes are similar using predetermined rigid motions and dilations. Recommend use after Lesson 6.
3. In cases where students did not have an opportunity to engage with Grade 8 Unit 8, consider using aspects of these lessons to introduce the Pythagorean Theorem and develop the ability to use it to solve for unknown side lengths.
    a. 8.8.6: First of three lessons in which students learn about Pythagorean Theorem
    b. 8.8.8: The purpose of this lesson is to use Pythagorean Theorem to find side lengths of right triangles</td><td>The following lessons are optional and can be removed at your discretion.

1. G.3.2 - optional lesson. Students practice finding an unknown and engage in an aspect of the modeling cycle. Recommend skipping.
2. G.3.10 - optional lesson. It goes beyond the scope of the standards. Recommend skipping or offering as an “Are You Ready for More?” option.</td></tr>
<tr><td>Lessons added: 1</td><td>Lessons removed: 2</td></tr>
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Modified Plan for Geometry Unit 3

Day	IM lesson	Notes
	assessment	Geometry Unit 3 Check Your Readiness assessment (CYR) Note that the Check Your Readiness assessment includes item-by-item guidance to inform just-in-time adjustments to instruction within the lessons in Geometry Unit 3.
1	G.3.1	Introductory lesson. Great place to welcome students back to dilations or a chance to see key elements of dilations. Focus on properties of dilations rather than how to dilate if students work on CYR Question1 indicates need.
2	G.3.3 8.2.5.1	The foundation for work to come in this unit. Include 8.2.5.1 "Many Dilations of a Triangle" digital applet to consolidate and synthesize discussion.
3	G.3.4	Builds on middle school understanding that dilations take angles to congruent angles and line to parallel lines, as well as examine what happens to lines that go through the center of dilation.
4	G.3.5	The synthesis of lessons leading up to this point, students use the definition of dilation to prove that the triangles formed by connecting midpoints of two sides are dilations of the original triangle.
5	G.3.6	Students work to develop generalized methods for using rigid transformation and dilations to show the similarity of any pair of triangles with all pairs of corresponding angles congruent and all pairs of corresponding side lengths proportional. Prepare to spend additional time on the activity Not-So-Rigid Transformations if students struggle with CYR Question 6.
6	8.2.6.4	This instructional activity gives students a structured opportunity to practice showing that two shapes are similar using a predetermined rigid motion and dilation.
7	G.3.7	Supports students to see the connection between the definition of similarity and making similarity statements.

8	G.3.8	Students prove that all equilateral triangles and all circles are similar.
9	G.3.9	Students prove the Angle-Angle Triangle Similarity Theorem. Key experience and understanding in this unit.
10	G.3.11	Students look for and make use of structure as they decide how they will prove two triangles are similar. This is a key experience and understanding in this unit.
11	G.3.12	Optional lesson. Gives students an additional opportunity to practice finding unknown values in proportional relationships using contextual examples. If students struggle with CYR Question 2, plan to do this lesson with a focus on calculating side lengths using the Pythagorean Theorem.
12	G.3.13	Grappling with right triangles inside a right triangle prepares students for high school level proof of the Pythagorean Theorem in Lesson 14.
13	G.3.14	Students prove the Pythagorean Theorem based on using the proportional relationships among the side lengths of the triangles.
15	G.3.15	Additional practice to use the strategies they have used to find unknown lengths in similar right triangles.
16	G.3.16	Gives students the opportunity to apply their understandings in indirect measurement and in situations like bank shots on pool tables.
17	assessment	End of Unit Assessment

Priority and Category List for Lessons

High priority (+), Medium priority (0), Low priority (-)

E: Explore, Play, and Discuss, D: Deep Dive, A: Synthesize and Apply

Lesson	Priority (+, 0, -)	Category (E, D, A)	Notes
G.3.1	0	E	Students review the definition of scale factor. In subsequent lessons students practice dilating points and figures. Builds on Grade 7 and 8 understandings. If students struggled with Question1 from the Check Your Readiness assessment, focus on the properties of dilations.
G.3.2	-	E	Optional lesson. Students practice finding an unknown value in a proportional relationship while engaging in parts of the modeling cycle. If students struggled with Question 2 from the Check Your Readiness assessment, consider exploring various methods for calculating proportional relationships within the context of this lesson.
G.3.3	+	D	This lesson gives students more opportunities to practice drawing dilations precisely by **reasoning about the definition of a dilation**. Students justify that the distance to the center of the dilation from the scaled figure and from the original figure have the same ratio as the scale factor because of how dilations are defined. This comes in to play several times throughout the unit, in particular Lesson 5 and Lesson 11.
G.3.4	0	D	In this lesson, students **verify experimentally and assert that dilations** take angles to congruent angles, and use this assertion to create a convincing argument that if dilations take angles to congruent angles, they must take lines to parallel lines. Students draw on their work with angles formed by parallel lines and transversals in an earlier unit to complete the proof. Students also reason based on the definition of dilation that lines that go through the center of the dilation, don't change under the dilation. All this in preparation for work on proving similarity theorems.
G.3.5	+	A	Students **use the definition** of dilation to prove that the triangles formed by connecting midpoints of two sides are dilations of the original triangle. The work in this lesson prepares students to later prove that pairs of triangles with certain properties must be

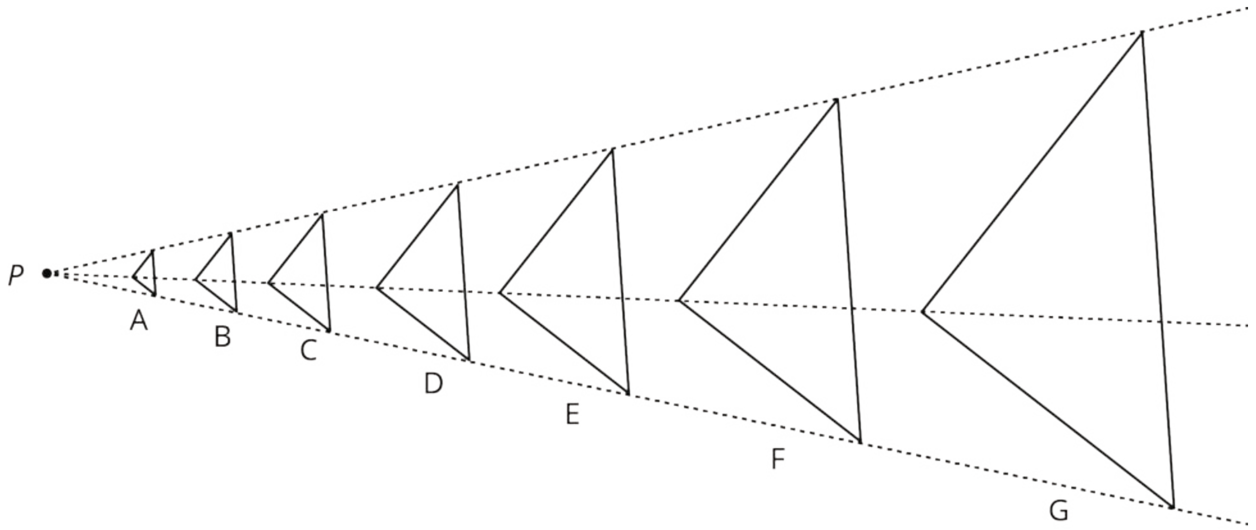
			dilations of one another, and therefore must be similar triangles.
G.3.6	0	E	Students **develop an informal understanding** of how to use rigid transformations and dilations to show the similarity of any pair of triangles with all pairs of corresponding angles congruent and all pairs of corresponding sides lengths proportional. Students learned the definition of similar figures grounded in transformations, they used grids to confirm specifics of their specific rigid motions. In a previous unit, students used the definitions of rigid transformations to prove triangle congruence theorems. In this lesson, students draw from their understanding of the relationship between congruence and rigid transformations and extend that to similarity and dilations. If students struggled with question 7 on the Check Your Readiness assessment, plan on spending some extra time focusing on similarity during the card sort activity.
G.3.7	0	E	Students use rigid transformation and dilations to reason about and **make generalizations** about similarity of triangles and other figures, drawing on the work they did in earlier lessons (Lessons 3–5).
G.3.8	0	D	Students conjecture and reason about whether all shapes in a certain category must be similar, such as all circles, or all rectangles, are similar. Students **get a chance to apply** the theorem they proved in previous lessons, that if two triangles have all pairs of corresponding angles congruent and all pairs of corresponding side lengths in the same proportion, then the triangles are similar.
G.3.9	+	D	Students use the Angle-Side-Angle Triangle Congruence Theorem as the basis for proving Angle-Angle Triangle Similarity Theorem. Prior to this lesson, students have been proving triangles similar using transformations to prove congruence (by scaling by an appropriate scale factor) to then be able to conclude that the triangles were similar. (HSG.SRT.A3) If students struggled with question 4 on the Check Your Readiness assessment, consider amplifying the work on solving for the unknown side lengths. If students struggled with question 9 in the Check Your Readiness assessment, consider amplifying the parts where asked to solve for unknown lengths. If students also struggled with question 1 from the Check Your Readiness assessment, consider using the terms complementary and supplementary to name ideas that surface during the lesson.
G.3.10	-	A	Optional Lesson. It goes beyond the scope of the standards. Students see why the Side-Side-Side Triangle Congruence Theorem implies the Side-Side-Side Triangle Similarity

			Theorem and why the SAS Triangle Congruence Theorem implies the SAS Triangle Similarity Theorem. This is an opportunity for students to practice creating viable arguments.
G.3.11	+	A	Students prove that a line parallel to one side of a triangle splits the other two sides proportionally (the converse of the theorem they studied in Lesson 5). Students can now conclude that a line is parallel to one side of a triangle if and only if it splits the other two sides proportionally. In doing this work, students must decide how they will prove that two triangles are similar: use sequences of transformation or apply the Angle-Angle Triangle Similarity Theorem.
G.3.12	-	A/E	Optional Lesson. It gives students an additional opportunity to practice finding unknown value in proportional relationships using contextual examples. Students also have a chance to use the Pythagorean Theorem, which will play a role in upcoming lessons.
G.3.13	0	E	This lesson prepares students for upcoming work in proving the Pythagorean Theorem using ratios of nested right triangles within a given right triangle. Students make sense of the similar triangles formed by drawing the altitude to the hypotenuse of a right triangle. Students also get a chance to practice using the Pythagorean Theorem, equivalent ratios, and scale factors to find unknown side lengths in similar right triangles. If students struggled with question 1 or 2 on the Check Your Readiness assessment, be sure to review complementary and supplementary angles prior to getting to this lesson and support students in developing proficiency with solving unknown sides of right triangles using the Pythagorean Theorem.
G.3.14	0	D	Students prove the Pythagorean Theorem based on the fact that right triangles (and only right triangles) can be decomposed into two similar versions of themselves. This proof is based on using the proportional relationships among the side lengths of the triangles.
G.3.15	-	A	Students have an opportunity to practice strategies they have used to find unknown lengths in similar right triangles. A key strategy is using proportional relationships within similar right triangles.
G.3.16	-	A	This lesson includes several summative application activities. There are two optional activities that involve going outside or to a room with very high ceilings to use indirect

			measurement to measure an object. The other activities focus on similar triangles and scale factors.

Activity 1: Many Dilations of a Triangle

All of the triangles are dilations of Triangle D. The dilations use the same center P, but different scale factors. What do Triangles A, B, and C have in common? What do Triangles E, F, and G have in common? What does this tell us about the different scale factors used?



Activity 4: Methods for Translations and Dilations

Your teacher will give you a set of five cards and your partner a different set of five cards. Using only the cards you were given, find at least one way to show that triangle ABC and triangle DEF are similar. Compare your method with your partner's method. What is the same about your methods? What is different?