Geometry Module 2

Topic A	**Scale Drawings**	**5 days**
Topic B	**Dilations**	**5 days**
Topic C	**Similarity and Dilations**	**15 days**
Topic D	**Applying Similarity to Right Triangles**	**7 days**
Topic D	**Trigonometry**	**13 days**

Just as rigid motions are used to define congruence in Module 1, so dilations are added to define similarity in Module 2.

To be able to define similarity, there must be a definition of similarity transformations and consequently a definition for dilations. Students are introduced to the progression of terms beginning with scale drawings, which they first study in Grade 7 (Module 1, Topic D), but in a more observational capacity than in Grade 10: Students determine the scale factor between a figure and a scale drawing or predict the lengths of a scale drawing, provided a figure and a scale factor. In Topic A, students begin with a review of scale drawings in Lesson 1, followed by two lessons on how to systematically create scale drawings. The study of scale drawings, specifically the way they are constructed under the Ratio and Parallel Methods, gives us the language to examine dilations. The comparison of why both construction methods (MP.7) result in the same image leads to two theorems: the Triangle Side Splitter Theorem and the Dilation Theorem. Note that while dilations are defined in Lesson 2, it is the Dilation Theorem in Lesson 5 that begins to tell us how dilations behave (**G-SRT.A.1**, **G-SRT.A.4**).

Topic B establishes a firm understanding of how dilations behave. Students prove that a dilation maps a line to itself or to a parallel line and, furthermore, dilations map segments to segments, lines to lines, rays to rays, circles to circles, and an angle to an angle of equal measure. The lessons on proving these properties, Lessons 7-9, require students to build arguments based on the structure of the figure in question and a handful of related facts that can be applied to the situation (e.g., the Triangle Side Splitter Theorem is called on frequently to prove that dilations map segments to segments, lines to lines, etc.) (MP.3, MP.7). Students apply their understanding of dilations to divide a line segment into equal pieces and explore and compare dilations from different centers.

In Topic C, students learn what a similarity transformation is and why, provided the right circumstances, both rectilinear and curvilinear figures can be classified as similar (**G-SRT.A.2**). After discussing similarity in general, the scope narrows and students study criteria for determining when two triangles are similar (**G- SRT.A.3**). Part of studying triangle similarity criteria (Lessons 15 and 17) includes understanding side length ratios for similar triangles which begins to establish the foundation for trigonometry (**G-SRT.B.5**). The final two lessons demonstrate the usefulness of

similarity by examining how two ancient Greek mathematicians managed to measure the circumference of the Earth and the distance to the Moon, respectively (**G-MG.A.1**).
In Topic D, students are laying the foundation to studying trigonometry by focusing on similarity between right triangles in particular (the importance of the values of corresponding length ratios between similar triangles particularly apparent in Lessons 16, 21, and 25). Students discover that a right triangle can be divided into two similar sub-triangles (MP.2) to prove the Pythagorean Theorem (**G-SRT.B.4**). Two lessons are spent studying the algebra of radicals that is useful for solving for sides of a right triangle and computing trigonometric ratios.

An introduction to trigonometry, specifically right triangle trigonometry and the values of side length ratios within right triangles, is provided in Topic E by defining the sine, cosine, and tangent ratios and using them to find missing side lengths of a right triangle (**G-SRT.B.6**). This is in contrast to studying trigonometry in the context of functions, as is done in Grade 11 of this curriculum. Students explore the relationships between sine, cosine, and tangent using complementary angles and the Pythagorean Theorem (**G-SRT.B.7**, **G-SRT.B.8**). Students discover the link between how to calculate the area of a non-right triangle through algebra versus trigonometry. Topic E closes with a study of the Laws of Sines and Cosines to apply them to solve for missing side lengths of an acute triangle (**G-SRT.D.10**, **G-SRT.D.11**).

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	TOPIC A				
1	Scale Drawings Students review properties of scale drawings and are able to create them.	Example 1 Exercise 1,2	1,2	Yes	1
2	Making Scale Drawings Using the Ratio Method	Example 1, 2 • Exercise 1	1, 3, 5	Yes	1

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	Students create scale drawings of polygonal figures by the Ratio Method. ▪ Given a figure and a scale drawing from the Ratio Method, students answer questions about the scale factor and the center.				
4	Comparing the Ratio Method and the Parallel Method Students relate the equivalence of the Ratio and Parallel Methods to the *Triangle Side Splitter Theorem*: A line segment splits two sides of a triangle proportionally if and only if it is parallel to the third side.	Side Splitter Theorem Discussion	1, 4, 5	Yes	1
5	Scale Factors Students prove the Dilation Theorem: If a dilation with center OO and scale factor rr sends point PP to PP' and QQ to QQ', then $\|PP'QQ'\|=rr\|PPPP\|$.	Focus on Dilation Theorem	1-2	Yes	2

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	Furthermore, if $r \neq 1$ and O, P, and Q are the vertices of a triangle, then $\overleftrightarrow{PQ} \parallel \overleftrightarrow{P'Q'}$. ▪ Students use the Dilation Theorem to show that the scale drawings constructed using the Ratio and Parallel Methods have a scale factor that is the same as the scale factor for the dilation.				
	TOPIC B				
6	Dilations as Transformations in the Plane Students review the properties of basic rigid motions. ▪ Students understand the properties of dilations and that a dilations is also an example of a transformation of the plane.	Exercises 1-6	1,2	Yes	1
7	How Do Dilations Map Segments?			Yes	1

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	Students prove that dilation $DD_{OO,}$ maps a line segment $PPPP$ to a line segment $PP'QQ'$, sending the endpoints to the endpoints so that $PP'_{QQ'}=rrrrrr$. If the center OO lies in line $PPPP$ or $rr=1$, then $PPPP$⃖⃗ = $PP'QQ'$⃖⃗. If the center OO does not lie in line $PPPP$ and $rr\neq1$, then $PPPP$⃖⃗ || $PP'QQ'$⃖⃗. ▪ Students prove that if $PPPP$ and $RRRR$ are line segments in the plane of different lengths, then there is a dilation that maps one to the other if and only if $PPPP$⃖⃗ = $RRRR$⃖⃗ or $PPPP$⃖⃗ || $RRRR$⃖⃗. **Be sure to post rule on classroom walls				
8	How Do Dilations Map Rays, Lines, and Circles ▪ Students prove that a			Yes	1

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	dilation maps a ray to a ray, a line to a line and a circle to a circle.				
9	How Do Dilations Map Angles ▪ Students prove that dilations map an angle to an angle with equal measure. ▪ Students understand how dilations map triangles, squares, rectangles, trapezoids, and regular polygons.			Yes	1
	TOPIC C				
12	What Are Similarity Transformations and Why Do We Need Them? Students define a *similarity transformation* as the composition of basic rigid motions and dilations. Students define two figures to be similar if there is a similarity transformation that takes one to the other. ▪ Students can describe a similarity transformation	Example 1 Exercises 1,2	1,2,3,4,6	Yes	2

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	applied to an arbitrary figure (i.e., not just triangles) and can use similarity to distinguish between figures that resemble each other versus those that are actually similar.				
13	Properties of Similarity Transformations ▪ Students know the properties of a similarity transformation are determined by the transformations that compose the similarity transformation. ▪ Students are able to apply a similarity transformation to a figure by construction	Example 1,2 Exercise 1	1, 3	Yes	1.5
14	Similarity ▪ Students understand that similarity is reflexive, symmetric, and transitive. ▪ Students recognize that if two triangles are similar, there is a correspondence such that corresponding pairs of angles have the	Examples 1-4	1,2,3,6	YES	2

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	same measure and corresponding sides are proportional. Conversely, they know that if there is a correspondence satisfying these conditions, then there is a similarity transformation taking one triangle to the other respecting the correspondence.				
15	Angle-Angle Criterion for Two Triangles to Be Similar ▪ Students prove the angle-angle criterion for two triangles to be similar and use it to solve triangle problems.	Exercises 1-5, 6, 7-10	1-3	Yes	2
16	Between Figure and Within Figure Ratios Students indirectly solve for measurements involving right triangles using scale factors, ratios between similar figures, and ratios within similar figures.	Opening Exercise Example 1,2, 3	1,2,3,5	Yes	2

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
17	SAS and SSS Criterion for Similar Triangles ▪ Students prove the side-angle-side criterion for two triangles to be similar and use it to solve triangle problems. ▪ Students prove the side-side-side criterion for two triangles to be similar and use it to solve triangle problems.	Opening Exercise Exploratory Challenge 1 Exploratory Challenge 2 Exercises 5-10	1,2	Yes	3
18	Similarity and the Angle Bisector Theorem ▪ Students state, understand, and prove the Angle Bisector Theorem. ▪ Students use the Angle Bisector Theorem to solve problems.	Opening Exercise 1-3 Discussion Exercises 4-7		Yes	1.5
	Mid-MODULE ASSESSMENT	Suggested problems: 1, 3-9, 11			
Topic D					
21	Special Relationships Within Right Triangles—Dividing into Two Similar Sub-Triangles	Opening exercise, Example 1, 2	1-3, 5	Yes	2 days

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	▪ Students understand that the altitude of a right triangle from the vertex of the right angle to the hypotenuse divides the triangle into two similar right triangles that are also similar to the original right triangle. ▪ Students complete a table of ratios for the corresponding sides of the similar triangles that are the result of dividing a right triangle into two similar sub-triangles.				
22	Multiplying and Dividing Expressions with Radicals ▪ Students multiply and divide expressions that contain radicals to simplify their answers. ▪ Students rationalize the denominator of a number expressed as a fraction.	Exercises 1-5, 6, 8, 10-13	1-7, 10,11	Yes	2 days
23	Adding and Subtracting Expressions with Radicals ▪ Students use the	Examples 1-6, Examples 1-3	1-6, 8	Yes	2 Days

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	distributive property to simplify expressions that contain radicals.				
TOPIC E					
25	Incredibly Useful Ratios ▪ For a given acute angle of a right triangle, students identify the opposite side, adjacent side, and hypotenuse. ▪ Students understand that the values of the $\mathrm{adj/hyp}$ and $\mathrm{opp/hyp}$ ratios for a given acute angle are constant.	Exercises 1-6, Exploratory Challenge, Exercises 7-10	1-8	Yes	2 days
26	The Definition of Sine, Cosine, and Tangent ▪ Students define sine, cosine, and tangent of $\theta\theta$, where $\theta\theta$ is the angle measure of an acute angle of a right triangle. Students denote sine, cosine, and tangent as $\sin$, $\cos$, and $\tan$, respectively. ▪ If $\angle A$ is an acute angle whose measure in degrees is θ, then we also say:	Exercises 1-7	1-9	Yes	3 Days

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	$\sin\angle A = \sin\theta$, $\cos\angle A = \cos\theta$, and $\tan\angle A = \tan\theta$. ▪ Given the side lengths of a right triangle with acute angles, students find sine, cosine, and tangent of each acute angle.				
27	Sine and Cosine of Complementary Angles and Special Angles ▪ Students understand that if $\alpha\alpha$ and $\beta\beta$ are the measurements of complementary angles, then $\sin\alpha\alpha = \cos\beta\beta$. ▪ Students solve triangle problems using special angles.	Example 1, Exercises 1-3,	1, 3	Yes	1 day
28	Solving Problems Using Sine and Cosine ▪ Students use graphing calculator to find the values of $\sin\theta\theta$ and $\cos\theta\theta$ for $\theta\theta$ between 0 and 90. ▪ Students solve for missing sides of a right triangle given the length of one side and the measure of one of the acute angles. ▪ Students find the length of the base of a triangle	Exercises 1-5	1, 2 5, 6	Yes	2 days

Lesson	Big Idea	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	with acute base angles given the lengths of the other two sides and the measure of each of the base angles.				
29	Applying Tangents ▪ Students understand that the value of the tangent ratio of the angle of elevation or depression of a line is equal to the slope of the line. ▪ Students use the value of the tangent ratio of the angle of elevation or depression to solve real-world problems.	Opening Exercise, Example 1,2, Exercise 1, 2	1-8	Yes	2 Days
30	Trigonometry and the Pythagorean Theorem	Exercises 1-2, Example 1, Exercises 3-4	1,3, 5, 6	Yes	2 Days