Geometry-R Module 1

Topic A	**Basic Constructions**	**6 days**
Topic B	**Unknown Angles**	**8 days**
Topic C	**Transformations/Rigid Motion**	**14 days**
Topic D	**Congruence**	**8 days**
Topic E	**Proving Properties of Geometric Figures**	**4 days**
Topic F	**Advanced Constructions**	**2 days**
Topic G	**Axiomatic Systems**	**4 days**

***This document is in draft form and will be changing as I am teaching along with you. I have put the date next to draft in the header; this will help you keep up with the changes. I welcome feedback on what you have found helpful and what has worked well with your students to add to this document.**

Geometry Module 1: Congruence, Proof, and Constructions

Module 1 embodies critical changes in Geometry as outlined by the Common Core. The heart of the module is the study of transformations and the role transformations play in defining congruence. The topic of transformations is introduced in a primarily experiential manner in Grade 8 and is formalized in Grade 10 with the use of precise language. The need for clear use of language is emphasized through vocabulary, the process of writing steps to perform constructions, and ultimately as part of the proof-writing process.

Topic A brings the relatively unfamiliar concept of construction to life by building upon ideas students are familiar with, such as the constant length of the radius within a circle. While the figures that are being constructed may not be novel, the process of using tools to create the figures is certainly new. Students use construction tools, such as a compass, straightedge, and patty paper, to create constructions of varying difficulty, including equilateral triangles, perpendicular bisectors, and angle bisectors. The constructions are embedded in models that require students to make sense of their space in addition to understanding how to find an appropriate solution with their tools. Students will also discover the critical need for precise language when they articulate the steps necessary for each construction. The figures covered throughout the topic provide a bridge to solving, then proving, unknown angle problems.

Topic B incorporates even more of these previously learned figures, such as the special angles created by parallel lines cut by a transversal. As part of the journey to solving proof problems, students begin by solving unknown angle problems in Lessons 6, 7, and 8. Students will develop mastery over problems involving angles at a point, angles in diagrams with parallel lines cut by a transversal, and angles within triangles, and all of the above within any given diagram. A base knowledge of how to solve for a given unknown angle lays the groundwork for orchestrating an argument for a proof. In the next phase, Lessons 9, 10, and 11, students work on unknown angle proofs. Instead of focusing on the computational steps needed to arrive at a particular unknown value, students must articulate the algebraic and geometric concepts needed to arrive at a given relationship. Students continue to

use precise language and relevant vocabulary to justify steps in finding unknown angles and to construct viable arguments that defend their method of solution.

Topic C students are reintroduced to rigid transformations, specifically rotations, reflections, and translations. Students first saw the topic in Grade 8 (**8.G.1-3**) and developed an intuitive understanding of the transformations, observing their properties by experimentation. In Topic C, students develop a more exact understanding of these transformations. Beginning with Lesson 12, they will discover what they do *not* know about the three motions. The lesson is designed to elicit the gap in students' knowledge, particularly the fact that they need to learn the language of the parameters of each transformation. During this lesson they will also learn to articulate what differentiates rigid motions from non-rigid motions. Students examine each transformation more closely in Lessons 13 through 16, developing precise definitions of each and investigating how rotations and reflections can be used to verify symmetries within certain polygons. In Lessons 17 and 18, students will use their construction skills in conjunction with their understanding of rotations and reflections to verify properties of parallel lines and perpendicular lines. With a firm grasp of rigid motions, students then define congruence in Lesson 19 in terms of rigid motions. They will be able to specify a sequence of rigid motions that will map one figure onto another. Topic C closes with Lessons 20 and 21, in which students examine correspondence and its place within the discussion of congruency.

Topic D, students use the knowledge of rigid motions developed in Topic C to determine and prove triangle congruence. At this point, students have a well-developed definition of congruence supported by empirical investigation. They can now develop understanding of traditional congruence criteria for triangles, such as SAS, ASA, and SSS, and devise formal methods of proof by direct use of transformations. As students prove congruence using the three criteria, they also investigate why AAS also leads toward a viable proof of congruence and why SSA cannot be used to establish congruence. Examining and establishing these methods of proving congruency leads to analysis and application of specific properties of lines, angles, and polygons in Topic E.

Topic E, students extend their work on rigid motions and proof to establish properties of triangles and parallelograms. In Lesson 28, students apply their recent experience with triangle congruence to prove problems

involving parallelograms. In Lessons 29 and 30, students examine special lines in triangles, namely midsegments and medians. Students prove why a midsegment is parallel to and half the length of the side of the triangle it is opposite from. In Lesson 30, students prove why the medians are concurrent.

Topic F, students are presented with the challenging but interesting construction of a nine-point circle in Lessons 31 and 32.

Topic G, students review material covered throughout the module. Additionally, students discuss the structure of geometry as an axiomatic system.

Lesson	Big Idea	2005 PI's	Emphasize	Suggested Problems (Problem Set)	Exit Ticket	Suggested Days
	TOPIC A			You can always go back to review the fundamental standards		
1	Students learn to construct an equilateral triangle. Students communicate mathematic ideas effectively and efficiently	G.G. 20	Opening Exercise Example 1 Relevant Vocabulary	1,2,3	yes	1
2	Students are challenged to construct a regular hexagon inscribed in a circle		Opening Exercise: Make it fun, if students did not do their homework: Use problem set 3 for lesson 1 and have students do as a warm up Exploratory Challenge 1 and 2	questions	yes	1
3	Students learn how to copy and bisect an angle	G.G. 17	Opening Exercise Discussion Example 1 and 2 Relevant Vocabulary	1-5	yes	1
4	Students learn to construct a perpendicular bisector and about the relationship between symmetry with respect to a line and a perpendicular bisector.	G.G. 18 G.G. 19	Discussion Mathematical Modeling Exercise Relevant Vocabulary	1-3	yes	1
5	Students learn points of concurrencies and understand why the points are concurrent	G.G. 21	Discussion – consider patty paper	1-3	none	1 to 2

	TOPIC B					
6	Students solve for unknown angles and cite geometric justification		Opening Exercise Discussion Example 1 Exercises 1-12	1-3	yes	1 to 2
7	Students solve for unknown angles and cite geometric justification (parallel lines cut by a transversal and use of auxiliary line)		Opening Exercise Discussion Example e Exercises 1 – 10 You choose	1-4	yes, you might want to change numbers	1 to 2
8	Students solve for unknown angles and cite geometric justification (angles in a triangle)	G.G. 30	Opening Exercise Discussion Exercises 1-11 You choose	1-3	yes	1
9	Students will write unknown angle proofs		Discussion Exercises 1-6 You choose	1,2	yes	1
10	Students will write unknown angle proofs involving auxiliary lines.		If time Opening Exercise Discussion	If time 1,2	If time yes	1
11	Students will write unknown angle proofs involving known facts		Discussion Example 1	1,2	yes	1

	TOPIC C					
12	Students identify the parameters they need to complete any rigid motion.		Opening Exercise 1,2 Discussion Relevant Vocabulary	1,2	yes	1
13	Students manipulate rotations by each parameter – center of rotation, angle of rotation and point under the rotation		Opening Exercise Simplify Discussion Exercises 1-5	In class 1-6	yes	1 to 2
14	Students learn the precise definition of a reflection Students construct the line of reflection of a figure and its reflected image Students construct the image of a figure when provided the line of reflection		Exploratory Challenge Example 1 – 3 Discuss example 4	1-4	yes	1
15	Students learn the relationship between a reflection and a rotation Students examine rotational symmetry within an individual figure		Opening Exercise Discussions Exercises 1-3	1-3, 4, 5,6	yes	1
16	(Refer to Lesson 2 of grade 8 Module 2) Students learn to precise definition of a translation and perform a translation by construction		Discussion Example 1	1-3,7 5 could be fun	yes	1
17	Student understands that any point on a line of reflection is		Opening Exercise Exercises 1-5	Yes	yes	1

	equidistant from any pair of pre-image and image points in a reflection					
18	Students learn to construct a line parallel to a given line through a point not on that line using a rotation by 180°. Students learn how to prove the alternate interior angles theorem using the parallel postulate and the construction.		All	1-6	yes	2 to 3
19	Students begin developing the capacity to speak and write articulately using the concepts of congruence. This involves being able to repeat the definition and use it in an accurate and effective way. "if there exists a finite composition of basic rigid motions that maps one figure onto the other"		All	1 and 2	yes	1
20	Students will understand that a congruence between figures gives rise to a correspondence between parts such that corresponding parts are congruent, and they will be able to state the correspondence that arises from a given congruence		Discussion Example 1	1 in class	yes	½

	Students will recognize that correspondences may be set up even in cases where no congruence is present, they will know how to describe and notate all the possible correspondences between two triangles or two quadrilaterals and they will know how to state a correspondence between two polygons					
21	Students will practice applying sequence of rigid motions from one figure onto another figure in order to demonstrate that the figures are congruent		Opening exercise Example 1 Exercises 1-3	1 and 2	yes	1
	Mid-Module Assessment		All			

	TOPIC D					
22	Students learn why any two triangles that satisfy the SAS congruence criterion must be congruent	GG 28 GG 29	Opening exercise Discussion Example 1 Exercises1-4	1-10 You choose	yes	1 to 2
23	Students examine two different proof techniques via a familiar theorem Students complete proofs involving properties of an isosceles triangle	GG 31	Opening Exercise Do two proofs for: base angles of an isosceles triangle are congruent. Exercises 1-5	1-3	yes, use of a transparency may help the students	1 to 2
24	Students learn why any two triangles that satisfy the ASA or SSS congruence criteria must be congruent	GG 28	Exercises 1-5	1, 2 Use 3 and 4 for group work in class	yes	1
25	Students learn why any two triangles that satisfy the AAS or HL congruence criteria must be congruent. Students learn why any two triangles that meet the AAA or SSA criteria are not necessarily congruent	GG 28	Opening Exercise Show counter examples for SSA and AAA Examples 1 and 2	1-4	yes	1
26	Students complete proofs requiring a synthesis of the skills learned in the last 4 lessons	GG 28	all	Try 1	yes	1
27	Students complete proofs requiring a synthesis of the skills learned in the last 4 lessons	GG 28	1-5	1	yes	1

	TOPIC E					
28	Students complete proofs that incorporate properties of parallelograms		Opening exercise Examples 1-7	1-5	yes	1 to 2
29	Students examine the relationship created by special lines in triangles namely the mid-segments	GG 42	Give rule or example Exercises 1-7	1 and 2	yes	1
30	Students examine the relationship created by special lines in triangles, namely medians	GG 43	Opening exercise Discussion Example 1-use patty paper Example 2 Example 3	In class	yes	1

	TOPIC F					
31	Students learn to construct a square and begin to construct a nine-point circle	GG 21	Opening Exercise Skip to lesson 33	1	yes	½
32	Students complete the construction of a nine-point circle.		OMIT			

	TOPIC G					
33	Review		All	1-4	yes	1
34	Review		All	1-5	yes	1
	End-0f-Module Assessment		All			