Mathematics Curriculum Guide

Honors Geometry

2017-18

Teaching for Understanding

- **Effective instruction begins with clarity about desired learning outcomes and about evidence that indicates learning has occurred, better known as "beginning with the end in mind." By starting with long-term results and working "backward," effective lesson planning occurs. The "backward planning" stages for a mathematics unit are:**

Stage One – Desired Results

"What are the long-term learning outcomes for my students?"

Teacher Actions:

- Review the Standards, Understandings, Essential Questions, Knowledge and Skills for the unit.
- Develop a deeper understanding of each math skill (*What is there to understand?*).
- Build connections within and between the unit's skills (*How are these understandings connected?*).

Stage Two – Evidence of Learning

"How will I know if my students understand the content?"

Teacher Actions:

- Design formative and summative assessments to inform instruction and gauge student progress towards desired results (Stage One).

Stage Three – Learning Experiences and Instruction

"What learning progression best supports my students? What learning experiences will build deep understanding and achieve my desired results?"

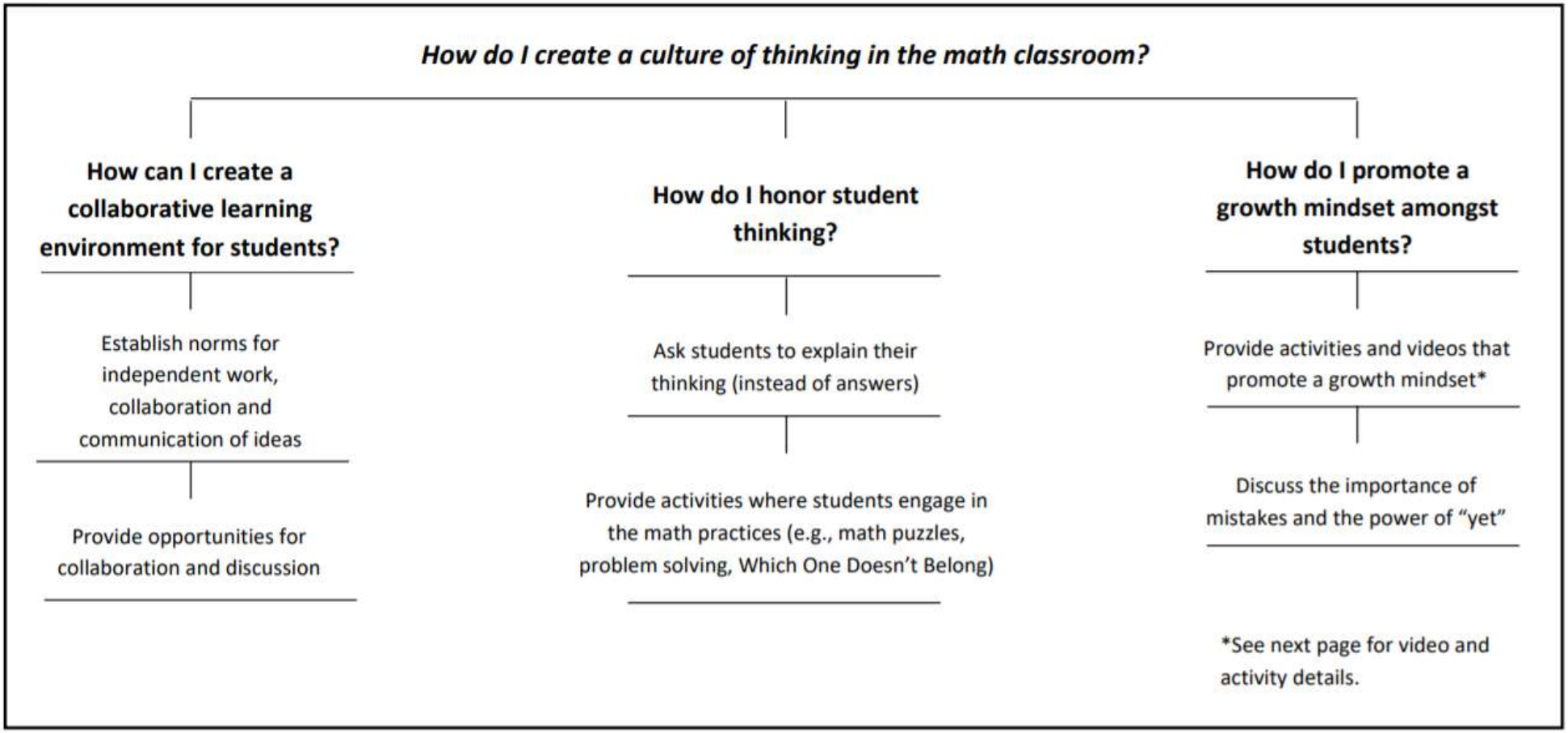
Teacher Actions:

- Determine students' understanding of prerequisite skills.
- With learning goals in mind, plan tasks that build conceptual knowledge, promote meaning making, connect mathematical concepts, and promote the mathematical practices.
- Teach for understanding.

- During the first three weeks of school, teachers will dedicate time during math instruction to create a mathematical mindset. A menu of activities can be selected by teachers to establish a healthy classroom environment, prepare students to engage in inquiry and problem-solving, and promote a positive growth mindset (see pages 3-4).

Create a Culture of Thinking

- **Creating a culture of thinking in the math classroom is a dedicated process that takes place throughout the entire school year. In order to lay the foundation, teachers will spend time during the first three days of school providing students with activities that establish an engaging learning community focused on problem solving, discourse and metacognition.**



Creating a Growth Mindset

Background

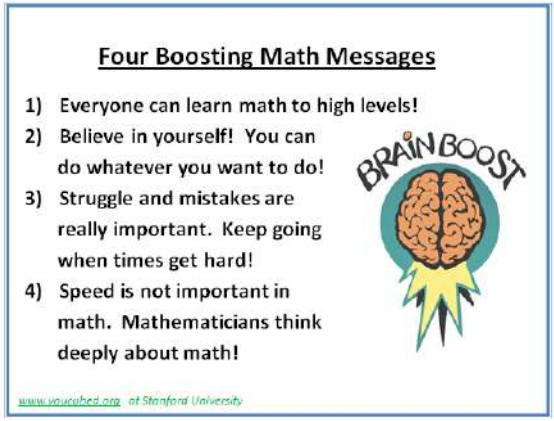
- The way a student reacts to academic challenges is directly related to whether or not the student has a growth mindset. The gap in student performance widens over time between those with a growth mindset and those with a fixed mindset.
- Teachers play a key role in developing growth mindset in students. To create a growth mindset culture, focus on the power of mistakes (download Jo Boaler's "Positive Classroom Norms"). Praise the process, not the person.
- Simply telling students to have a growth mindset can backfire. A scientific explanation about how intelligence works – that the brain can get stronger and smarter with new learning – has been demonstrated to be effective.
- Reiterating the message "just try harder" can also be problematic. A growth mindset isn't about trying harder. Students need to understand why they should put in effort and how to deploy that effort.

Secondary Videos

- Neuroplasticity (2:03) https://www.youtube.com/watch?v=ELpfYCZa87g
- The science behind Growth Mindset (3:04) https://www.youtube.com/watch?v=WtKJrB5rOKs
- Four Boosting Math Messages from Jo and Her Students (8:35) https://www.youcubed.org/students/
- John Legend: Success through effort (2:01) https://www.youtube.com/watch?v=LUtcigWSBsw

Discussion Questions

- How do you feel when you make a mistake? Why?
- How do you think other people see you when you make a mistake?
- Have you ever discovered something new from making a mistake?
- Have you ever felt proud of making a mistake?
- Has a mistake ever made you think more deeply about a problem? (start non-academic and then talk about how the lessons apply to academics)



The Power of "Yet"

- Turn a fixed mindset comment into a growth mindset statement by adding 'yet' to the end of the comment.
- Video: Sesame Street: Janelle Monae – Power of Yet (2:41) https://www.youtube.com/watch?v=XLeUvZvuvAs
- When grading student work, be it formative or summative, create a cut off point for what you would consider mastery. All work that does not meet this expectation is marked NOT YET. When returned to students, explain that they are to revise work and provide guidelines and structure for students to fix their assignments and demonstrate mastery.

Activities

- Design a poster comparing growth and fixed mindsets
- Write growth mindset hashtags and post around the classroom
- Turn the transfer goals into "I will…" statements
- Challenge students with a math puzzle and focus on using growth mindset language (I can't get the answer… yet)
- Answer a "Dear Abby" letter from a student who feels like a failure
- Give each student a piece of paper. Ask them to crumple it up and throw it at the board with the feelings they have when they make a mistake in math. Get them to retrieve the paper, uncrumple it, and color each line with different colors. Tell your students that these lines represent all the synaptic activity that happens when a mistake is made. Explain how they can learn from mistakes. Ask them to keep the paper and stick it into a notebook or folder to look at when they make a mistake. This physical reminder prompts students to use mistakes to strengthen their brain every time they open their notebook.

Topic 1: Tools of Geometry

In this unit students will understand that geometry is a mathematical system built on accepted facts, basic terms, and definitions. Students will learn that postulates and axioms are accepted statements of fact, and can be used as the basic building blocks of the logical system in geometry. Additionally, students will use number operations to find and compare lengths of segments and measures of angles to identify geometric relationships. They will begin to apply logical reasoning to solve problems and justify their reasoning using properties, given information, definitions, postulates, and theorems. The ultimate goal of this unit is for students to understand the basic building blocks of geometry and begin to use logically reason through mathematical ideas.

Common Misconceptions:

- **Measuring Segments:** When measuring the length of a segment on a number line, students might forget how to subtract a negative number. When using the Distance Formula, students are often confused about which point is the first and which point is the second. It does not matter which pint is considered the first point or the second point as long as the elements from an ordered pair are used consistently. Have students label their ordered pairs as (x_1, y_1) and (x_2, y_2).
- **Complementary and Supplementary Angles:** Students will often confuse complementary and supplementary angles, thinking that angle pairs that sum to 180° are complementary and angle pairs that sum to 90° are supplementary. One way of remembering this is to think that 90 comes before 180 and C comes before S in the alphabet.

Topic 1: Tools of Geometry

Transfer Goals

1) Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution.
2) Effectively communicate orally, in writing, and using models (e.g., concrete, representational, abstract) for a given purpose and audience.
3) Construct viable arguments and critique the reasoning of others using precise mathematical language.

Timeframe: 3 weeks/15 days
Start Date: August 17, 2017
Assessment Dates: Sept. 6-7, 2017

Standards

G-CO-1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line.

G-CO-12 Make formal geometric constructions with a variety of tools and methods…

G-GPE-4 Use coordinates to prove simple geometric theorems, algebraically…

Meaning-Making

Understandings

Students will understand that…

- Geometry is built upon basic geometric principles and figures (ex: point, line, plane, etc.).
- A postulate or axiom is an accepted statement of fact.
- Number operations can be used to find and compare the lengths of segments. The Ruler and Segment Addition Postulates can be used in reasoning about lengths.
- Number operations can be used to find and compare the measures of angles. The Protractor and Angle Addition Postulates can be used in reasoning about angle measures.
- Special angle pairs, such as adjacent, vertical, complementary, and supplementary angles, can be used to identify geometric relationships and to find angle measures.
- Special geometric tools can be used to make a figure that is congruent to an original figure without measuring. Construction with straightedge and compass is more accurate than sketching and drawing.
- Formulas can be used to find the midpoint of a segment and the distance between two points in the coordinate plane.
- Perimeter, circumference, and area are different ways of measuring the size of geometric figures.
- The area of a region is the sum of the areas of its non-overlapping parts.

Essential Questions

Students will keep considering…

- How do we name objects in geometry?
- How can you determine the length of a line segment, and if two segments are congruent?
- How do we find or calculate the length of a segment?
- How can you determine if two angles are the same size?
- How are degrees used to measure and classify angles?
- How can you use special angle pairs and their relationships to find angle measures?
- How do we create basic constructions using a straightedge and a compass?
- How can you find the midpoint of a segment?
- How can you find the distance between two points in the coordinate plane?
- What is the difference between a figure's perimeter and its area?

Acquisition

Knowledge

Students will know…

Vocabulary: point, line, plane, collinear points, coplanar, space, segment, ray, opposite rays, postulate, axiom, intersection, coordinate, distance, congruent segments, midpoint, segment bisector, angle, sides, vertex, exterior, interior, measure of an angle, acute angle, obtuse angle, right angle, straight angle, congruent angles, adjacent angles, vertical angles, complementary angles, supplementary angles, linear pair, linear pair postulate, angle bisector, straightedge, compass, construction, perpendicular lines, perpendicular bisector, midpoint formula, distance formula, perimeter, area

- **Postulates:** Ruler, Segment Addition, Protractor, Angle Addition, Area Addition
- **Properties:** Equality, Distributive, Congruence
- **Theorems:** Vertical Angles, Congruent Supplements, Congruent Compliments
- **Formulas:** Midpoint, Distance, various Area Formulas, various Perimeter Formulas

Skills

Students will be skilled at and able to do the following…

- Name geometric figures with proper notation (ex: name a line multiple ways)
- Show and recognize segment congruence in diagrams.
- Differentiate between $\overline{AB}$ and AB as well as between $\overline{AB} \cong \overline{CD}$ and AB = CD.
- Use the Ruler and Segment Addition Postulates to find and compare length.
- Name, measure, and identify angles when given its name and a diagram
- Identify angle pair relationships given a diagram, and find their measures.
- Create a variety of constructions using a straightedge and a compass.
- Find the midpoint of a segment.
- Find the distance between two points in the coordinate plane.
- Find the perimeter (or circumference) and area of basic shapes.

Topic 1: Tools of Geometry

Transfer is a student's ability to independently apply understanding in a novel or unfamiliar situation. In mathematics, this requires that students use reasoning and strategy, not merely plug in numbers in a familiar-looking exercise, via a memorized algorithm.

Transfer goals highlight the effective uses of understanding, knowledge, and skills we seek in the long run – that is, what we want students to be able to do when they confront new challenges, both in and outside school, beyond the current lessons and unit. These goals were developed so all students can apply their learning to mathematical or real-world problems while simultaneously engaging in the Standards for Mathematical Practices. In the mathematics classroom, assessment opportunities should reflect student progress towards meeting the transfer goals.

With this in mind, the revised **PUSD transfer goals** are:

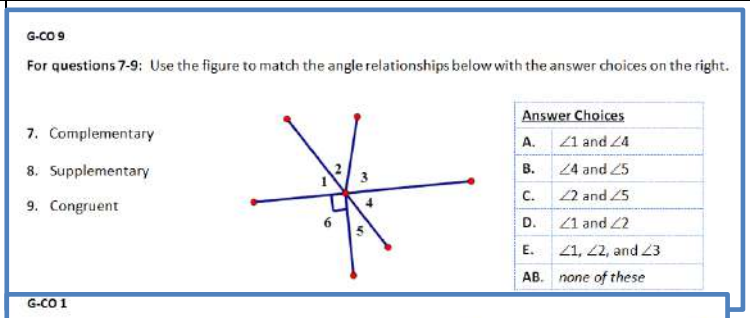
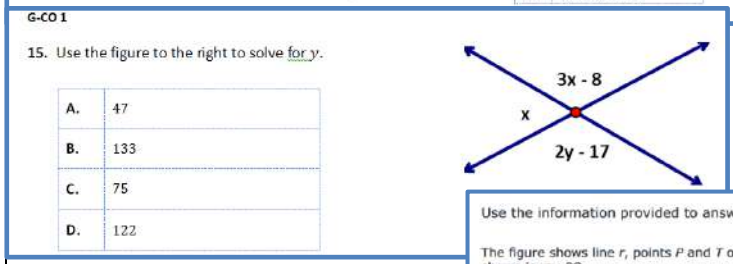
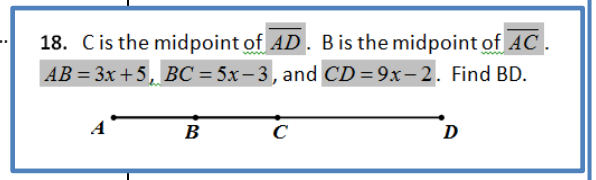
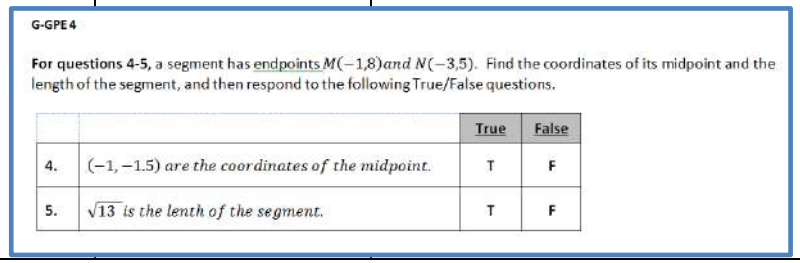
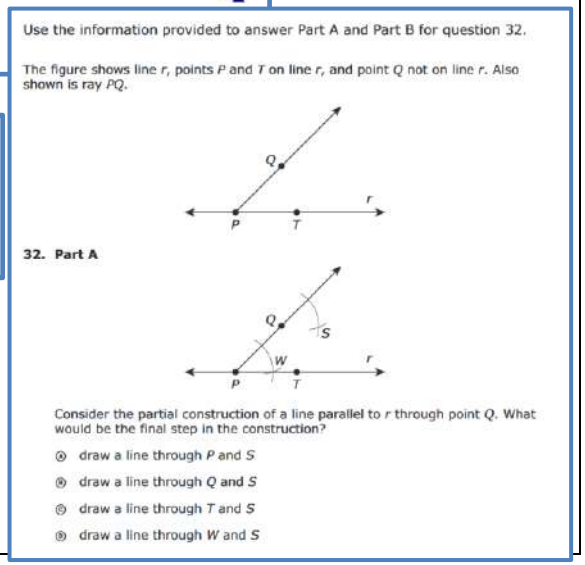
1) **Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution.**
2) **Effectively communicate orally, in writing, and by using models (e.g., concrete, representational, abstract) for a given purpose and audience.**
3) **Construct viable arguments and critique the reasoning of others using precise mathematical language.**

Multiple measures will be used to evaluate student acquisition, meaning-making and transfer. Formative and summative assessments play an important role in determining the extent to which students achieve the desired results in stage one.

Formative Assessment	Summative Assessment
Aligning Assessment to Stage One	
• What constitutes evidence of understanding for this lesson? • Through what other evidence during the lesson (e.g. response to questions, observations, journals, etc.) will students demonstrate achievement of the desired results? • How will students reflect upon, self-assess, and set goals for their future learning?	• What evidence must be collected and assessed, given the desired results defined in stage one? • What is evidence of understanding (as opposed to recall)? • Through what task(s) will students demonstrate the desired understandings?
Opportunities	
• Discussions and student presentations • Checking for understanding (using response boards) • Ticket out the door, Cornell note summary, and error analysis • *Performance Tasks* within a Unit • Teacher-created assessments/quizzes	• Unit assessments • Teacher-created quizzes and/or mid-unit assessments • *Illustrative Mathematics* tasks (https://www.illustrativemathematics.org/) • Performance tasks

Topic 1: Tools of Geometry

The following pages address how a given skill may be assessed. Assessment guidelines, examples and possible question types have been provided to assist teachers in developing formative and summative assessments that reflect the rigor of the standards. *These exact examples cannot be used for instruction or assessment, but can be modified by teachers.*

Unit Skills	SBAC Targets (DOK)	Standards	Examples
• Name geometric figures with proper notation (ex: name a line multiple ways) • Show and recognize segment congruence in diagrams. • Differentiate between $\overline{AB}$ and AB as well as between $\overline{AB} \cong \overline{CD}$ and AB = CD. • Use the Ruler and Segment Addition Postulates to find and compare length. • Name, measure, and identify angles when given its name and a diagram • Identify angle pair relationships given a diagram, and find their measures. • Create a variety of constructions using a straightedge and a compass. • Find the midpoint of a segment. • Find the distance between two points in the coordinate plane. • Find the perimeter (or circumference) and area of basic shapes.	Select and use appropriate tools strategically. (1,2) State logical assumptions being used. (2,3) Distinguish correct logic or reasoning form that which is flawed and – if there is a flaw in the argument – explain what it is. (2,3,4) Base arguments on concrete referents such as objects, drawings, diagrams, and actions. (2,3)	G-CO-1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line. G-CO-12 Make formal geometric constructions with a variety of tools and methods… G-GPE-4 Use coordinates to prove simple geometric theorems, algebraically…	    

Topic 1: Tools of Geometry

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Essential Questions:

- How do we name objects in geometry?
- How can you determine the length of a line segment, and if two segments are congruent?
- How do we find or calculate the length of a segment?
- How can you determine if two angles are the same size?
- How are degrees used to measure and classify angles?
- How can you use special angle pairs and their relationships to find angle measures?
- How do we create basic constructions using a straightedge and a compass?
- How can you find the midpoint of a segment?
- How can you find the distance between two points in the coordinate plane?
- What is the difference between a figure's perimeter and its area?

Standards: G-CO 1 , G-CO 12, G-GPE 4, N-Q 1 (Algebra)

Timeframe: 3 weeks/15 days
Start Date: August 17, 2017
Assessment Dates: Sept. 6-7, 2017

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Resources
1 Day (Aug. 17)	**Topic Opener – Pg 3 Solving a Riddle Class Procedures & Algebra Review**					
2 Days (Aug. 18 & 21)	**Lesson 1-2: Points, Lines, and Planes** SMP: 1,3,4,6 (pp. 11-19) **G-CO 1**	**Focus Question:** • How do we name objects in geometry? **Inquiry Question:** **1-2** Solve It! Pg 11	• Geometry is a mathematical system built on accepted facts, basic terms, and definitions. • A postulate or axiom is an accepted statement of fact.	**Vocabulary:** point, line, plane, collinear, coplanar, space, segment, ray, opposite rays, postulate, axiom, intersection	• Recognize and use basic geometric terms and definitions. • Use correct notation to name basic geometric terms.	**Common Core Problems:** #37, 38, 39, 46 **Thinking Map:** Circle Map with object names and pictures.
1 Day (Aug. 22)	**Lesson 1-3: Measuring Segments** SMP: 2,3,4,6 (pp. 20-26) **G-CO 1**	**Focus Questions:** • How can you determine if two segments are congruent? • How do we find or calculate the length of a segment? **Inquiry Question:** **1-3** Solve It! Pg 20	• Number operations can be used to find and compare the lengths of segments. • The Ruler and Segment Addition Postulates can be used in reasoning about lengths.	**Vocabulary:** coordinate, distance, congruent segments, midpoint, segment bisector • Ruler postulate • Segment Addition Postulate	• Show and recognize segment congruence in diagrams. • Differentiate between $\overline{AB}$ and AB as well as between $\overline{AB} \cong \overline{CD}$ and AB = CD. • Use the Ruler and Segment Addition Postulates to find and compare length. • Use the idea of congruence to determine if a point is a midpoint.	**Common Core Problems:** #35, 37, 38, 41

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
1 Day (Aug. 23)	**Lesson 1-4: Measuring Angles** SMP: 1,3,6 (pp. 27-33) **G-CO 1**	**Focus Questions:** • How can you determine if two angles are the same size? • How are angles classified? **Inquiry Question:** **1-4** Solve It! Pg 27	• Number operations can be used to find and compare the measures of angles. • The Protractor and Angle Addition Postulates can be used in reasoning about angle measures.	**Vocabulary:** angle, sides, vertex, exterior, interior, measure of an angle, acute angle, obtuse angle, right angle, straight angle, congruent angles **Concept:** • Protractor and Angle Addition Postulate	• Name angles three ways. • Identify an angle when given its name and a diagram. • Show and recognize segment congruence in diagrams. • Use Protractor and Angle Addition Postulates to find and compare angle measures. • Measure angles using a protractor.	**Common Core Problems:** #28, 39, 40 **Thinking Map:** Tree Map with types of angles.
2 Days (Aug. 24, 25)	**Lesson 1-5: Exploring Angle Pairs** SMP: 1,3,4,6 (pp. 34-40) **G-CO 1**	**Focus Questions:** • How can you use special angle pairs and their relationships to find angle measures? **Inquiry Question:** **1-5** Solve It! Pg 34	• Special angle pairs, such as adjacent, vertical, complementary, and supplementary angles, can be used to identify geometric relationships and to find angle measures.	**Vocabulary & Concepts:** adjacent angles, vertical angles, complementary angles, supplementary angles, linear pair, linear pair postulate, angle bisector	• Identify angle pair relationships given a diagram. • Use angle pair relationships to find and compare angle measures.	**Common Core Problems:** #31, 38, 39, 41 **Thinking Map:** Bridge Map with types of angle pairs.
1 Day (Aug. 28th)	**Topic 1 Performance Task (p. 69)**					
1 Day (Aug. 29th)	**Lesson 1-6: Basic Constructions** SMP: 1,3,4,6 (pp. 43-48) **G-CO 12**	**Focus Questions:** • How do we create basic constructions using a straightedge and a compass? • How can we bisect an angle without using a protractor? **Inquiry Question:** **1-6** Solve It! Pg 43	• Special geometric tools can be used to make a figure that is congruent to an original figure without measuring. • Constructions with straightedge and compass are more accurate than sketching and drawing.	**Vocabulary & Concepts:** straightedge, compass, construction, perpendicular lines, perpendicular bisector	• Create a variety of constructions using a straightedge and a compass.	**Common Core Problems:** #20, 25, 26, 31, 34 Teachers can also go to : https://www.mathsisfun.com/geometry/constructions.html

Common Core Practices

- ☐ Instruction in the Standards for Mathematical Practices
- ☐ Use of Talk Moves
- ☐ Note-taking
- ☐ Use of Manipulatives
- ☐ Use of Technology
- ☐ Use of Real-world Scenarios
- ☐ Project-based Learning
- ☐ Thinking Maps

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
2 Days (Aug. 30 - 31)	**Lesson 1-7: Midpoint and Distance in the Coordinate Plane** SMP: 1,3,4 (pp. 50-56) **G-GPE 4**	**Focus Questions:** • How can you find the midpoint of a segment? • How can you find the distance between two points in the coordinate plane? **Inquiry Question:** **1-7** Solve It! Pg 50	• Formulas can be used to find the midpoint of a segment and the distance between two points in the coordinate plane.	**Vocabulary & Concepts:** midpoint, distance **Concept:** Midpoint Formula, Distance Formula	• Find the midpoint of a segment given both endpoints. • Find the distance between two points in the coordinate plane. • Find the endpoint of a segment given one endpoint and the midpoint.	**Common Core Problems:** #45, 46, 57 **Problem 4 (p. 53)** **Thinking Map:** Flow Maps to show the steps when solving with the midpoint formula and with the distance formula.
1 Day (Sept. 1)	**Lesson 1-8: Perimeter, Circumference, and Area** SMP: 1,3,4,7 (pp. 59-69) **N-Q 1**	**Focus Questions:** • What is the difference between a figure's perimeter and its area? **Inquiry Question:** **1-8** Solve It! Pg 59	• Perimeter, circumference, and area are different ways of measuring the size of geometric figures. • The area of a region is the sum of the areas of its non-overlapping parts.	**Vocabulary & Concepts:** perimeter, circumference, area **Concept:** Area Addition Postulate, Area Formulas, Perimeter Formulas	• Find the perimeter or circumference of basic shapes. • Find the area of basic shapes.	**Common Core Problems:** #38, 40, 47, 48 **Thinking Map:** Tree Map for Square, Rectangle, Triangle, and Circle to show figures and formulas for each figure.
1 day (Sept. 5th)	**Review Topic 1 Concepts & Skills** Use Textbook Resources and/or Teacher Created Items					
2 days (Sept. 6-7)	**Topic 1 Assessment** (Created and provided by PUSD)					

Common Core Practices

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