Mathematics Curriculum Guide

Honors Geometry

2017-18

Creating a Growth Mindset

Background

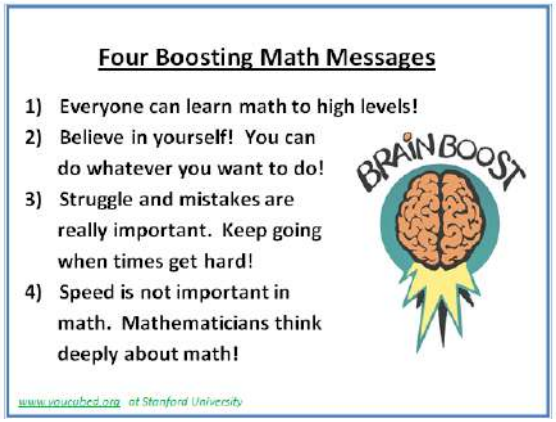
- The way a student reacts to academic challenges is directly related to whether or not the student has a growth mindset. The gap in student performance widens over time between those with a growth mindset and those with a fixed mindset.
- Teachers play a key role in developing growth mindset in students. 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.

Creating a Mathematical Mindset Classroom

Establishing a Positive Environment

- Share expectations
- Icebreaker activities
- Establish positive rules
- Practice classroom procedures
- Set individual and classroom goals
- Establish expectations for collaborative work and discussions

Setting the Stage for Inquiry-Based Instruction

- Understand the transfer goals and their important role
- Discuss the role of UPSC
- Build a learning community

Promoting a Growth Mindset

- Watch videos that promote a growth mindset
- Discuss the importance of mistakes
- Discover the power of "yet"
- Engage in a variety of growth mindset activities

** See next page for video and activity details.

Other

What's New in 2017-18?

- "Begin with the end in mind." The most successful teaching begins with clarity about desired learning outcomes and about evidence that indicates learning has occurred. By starting with long-term results and working "backward," effective lesson planning occurs. This year's mathematics curriculum guides are organized into three "backward planning" stages:

Stage One – Desired Results

Stage one focuses on the long-term learning outcomes for students. The desired results of the unit provide the framework for the unit of instruction. Included in this section are:

- Narrative overview of the unit with common misconceptions
- Unit Overview that includes standards, understandings, essential questions, knowledge and skills for the unit
- Revised transfer goals that address the overarching, long-term learning outcomes

Stage Two – Evidence of Learning

This stage helps teachers answer the question, "How will I know if my students *understand* the content?" Determining the evidence of learning prior to instruction is a key aspect of backward planning. Included in this section are:

- The role of transfer goals in assessment
- Opportunities to use multiple measures to assess the desired results in stage one
- Examples of assessment questions

Stage Three – Learning Experiences & Instruction

In stage three we plan for the most appropriate learning experiences and needed instruction. The purpose of this stage is to develop a learning plan that aligns to the desired results and evidence of learning. Included in this section are:

- Instructional sequence, including learning and transfer goals for each lesson

- 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).

Topic 2: Reasoning and Proof

In this unit students are introduced to topics related to reasoning. Students will learn inductive and deductive reasoning. They will solve equations giving reasons for each step and will connect this to simple two-column and parallel proofs. The ultimate goal of this unit is for students to prove geometric relationships using given information, definitions, properties, postulates, and theorems.

Common Misconceptions:

- **Inductive Reasoning:** Students might conjecture by inductive reasoning without considering possible counterexamples. For example, if three lines are randomly generated on a coordinate plane, the three lines may form a triangle. It may be tempting to conjecture that three lines on the coordinate plane always form a triangle. However, a counterexample of three parallel lines can be given as possible.
- **Deductive Reasoning:** Students might incorrectly use the Law of Detachment. They may see that the conclusion of a statement is true and assume that the premise is true, but that is not always the case.
- **Proofs:** Working with proofs is often a daunting task for many students. The number of mathematical properties, theorems, definitions, etc. can be overwhelming. Some students may benefit from working backward. Have them start with the statement they'd like to prove and identify what information is needed to get to that statement.

Topic 2: Reasoning and Proof

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: Sept. 8, 2017
Assessment Dates: Sept. 27-28, 2017

Standards

G-CO 9 Prove theorems about lines and angles. Theorems include: vertical angles are congruent; ~~when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.~~

Meaning-Making

Understandings

Students will understand that…

- Some mathematical relationships can be described using a variety of if-them statements.
- A definition is good if it can be written as a biconditional.
- Given true statements, deductive reasoning can be used to make a valid or true conclusion.
- Algebraic properties of equality are used in geometry to solve problems and justify reasoning.
- Given information, definitions, properties, postulates, and previously proven theorems can be used as reasons in a proof.

Essential Questions

Students will keep considering…

- How can you conclude that a conditional statement is true?
- What is the purpose of a definition, and how can we determine if that definition is good?
- What elements make an argument logical?
- How can we organize a written argument?
- How do we write and justify a series of logical steps to reach a conclusion?
- What are some ways that we can prove two angles are congruent?

Acquisition

Knowledge

Students will know…

Vocabulary: conditional, hypothesis, conclusion, truth value, negation, converse, inverse, contrapositive, equivalent statements, biconditional, deductive reasoning, Law of Detachment, Law of Syllogism, sound or logical arguments, Reflexive Property, Symmetric Property, Transitive Property, proof, two-column proof, theorem, paragraph proof, Vertical Angles Theorem, Congruent Supplements Theorem, Congruent Complements Theorem

- **Properties:** Law of Detachment, Law of Syllogism, Reflexive Property, Symmetric Property, Transitive Property
- **Theorems:** Vertical Angles Theorem, Congruent Supplements Theorem, Congruent Complements Theorem

Skills

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

- Recognize conditional statements and their parts.
- Write converses, inverses, and contrapositives of conditionals.
- Write biconditional statements.
- Determine the validity of a definition.
- Use the Law of Detachment and the Law of Syllogism to draw logical conclusions from statements.
- Construct arguments using the deductive structure which include the Laws of Syllogism and Detachment.
- Connect reasoning in algebra and geometry.
- Use the two-column format to write deductive proofs using algebraic properties.
- Prove and apply theorems about angles.
- Use two-column and paragraph proofs formats to write deductive proofs proving angles are congruent.

Topic 2: Reasoning and Proof

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:

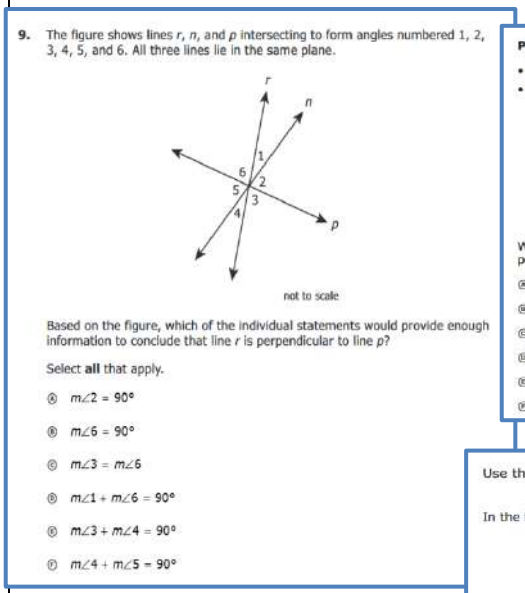
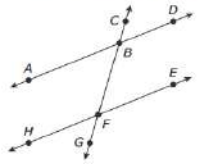
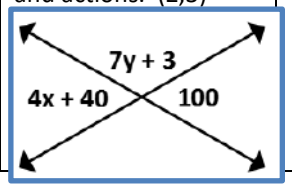
1) **Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution.**
2) **Effectively communicate orally, in writing, and by using models (e.g., concrete, representational, abstract) for a given purpose and audience.**
3) **Construct 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 2: Reasoning and Proof

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
• Recognize conditional statements and their parts. • Write converses, inverses, and contrapositives of conditionals. • Write biconditional statements. • Determine the validity of a definition. • Use the Law of Detachment and the Law of Syllogism to draw logical conclusions from statements. • Construct arguments using the deductive structure which include the Laws of Syllogism and Detachment. • Connect reasoning in algebra and geometry. • Use the two-column format to write deductive proofs using algebraic properties. • Prove and apply theorems about angles. • Use two-column and paragraph proofs formats to write deductive proofs proving angles are congruent.	Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. (3,4) State logical assumptions being used. (2,3) Use the technique of breaking an argument into cases. (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 9 Prove theorems about lines and angles. Theorems include: vertical angles are congruent; ~~when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent: points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.~~	 9. The figure shows lines *r*, *n*, and *p* intersecting to form angles numbered 1, 2, 3, 4, 5, and 6. All three lines lie in the same plane. not to scale Based on the figure, which of the individual statements would provide enough information to conclude that line *r* is perpendicular to line *p*? Select **all** that apply. A $m\angle 2 = 90°$ B $m\angle 6 = 90°$ C $m\angle 3 = m\angle 6$ D $m\angle 1 + m\angle 6 = 90°$ E $m\angle 3 + m\angle 4 = 90°$ F $m\angle 4 + m\angle 5 = 90°$
			Part B • Given: $m\angle CBD = m\angle BFE$ • Prove: $m\angle BFE + m\angle DBF = 180°$ Statement / Reason $m\angle CBD = m\angle BFE$ / Given $m\angle CBD + m\angle DBF = 180°$ / $m\angle BFE + m\angle DBF = 180°$ / Which **two** of the given reasons could be used to correctly complete the proof? A Adjacent angles are congruent B Adjacent angles are supplementary C Linear pairs of angles are supplementary D Reflexive property of equality E Substitution property of equality F Transitive property of equality
			Use the information provided to answer Part A and Part B for question 30. In the figure shown, $\overline{CF}$ intersects $\overline{AD}$ and $\overline{EH}$ at points *B* and *F*, respectively.  **30. Part A** • Given: $\angle CBD \cong \angle BFE$ • Prove: $\angle ABF \cong \angle BFE$ Statement / Reason $\angle CBD \cong \angle BFE$ / Given $\angle CBD \cong \angle ABF$ / $\angle ABF \cong \angle BFE$ / Which **two** of the given reasons could be used to correctly complete the proof? A Definition of congruent angles B Congruence of angles is reflexive C Congruence of angles is symmetric D Congruence of angles is transitive E Vertical angles are congruent
			4. Which of the following statements **cannot** be written as a true biconditional? **(Select ALL that apply.)** A. If the sum of two angles is 180°, then the angles are supplementary. B. If an angle measures 37°, then it is acute. C. If R is between T and M, then TR + RM = TM. D. If two angles have the same measure, then they are congruent. E. If two angles have a sum of 90°, then they are both acute. G-CO 9 5. Which type of reasoning allows the conclusion given for the following true statement? "If you have Mr. Gonzalez for geometry, then you take geometry in room 49." Petra has Mr. Gonzalez for geometry. Petra's geometry class is in room 49. A. Law of Detachment B. Law of Syllogism C. Inductive reasoning D. None of the above
			 7y + 3 4x + 40 100

Topic 2: Reasoning and Proof

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.

Essential Questions:	**Standards:** G-CO 9
• How can you conclude that a conditional statement is true? • What is the purpose of a definition, and how can we determine if that definition is good? • What elements make an argument logical? • How can we organize a written argument? • How do we write and justify a series of logical steps to reach a conclusion? • What are some ways that we can prove two angles are congruent?	**Timeframe:** 3 weeks/15 days **Start Date:** September 8, 2017 **Assessment Dates:** September 27-28, 2017

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Resources
1 Day (Sept 8th)	**Topic Opener** pg. 81 Analyzing a Calendar Pattern					
2 Days (Sept. 9th & 12th)	**Lesson 2-2: Conditional Statements** SMP: 3,6,7 (pp. 89-95) G-CO 9	**Focus Question:** • How can we write a statement as a conditional statement? • How can you conclude that a conditional statement is true? **Inquiry Question:** **2-2** Solve It! pg. 89	• Some mathematical relationships can be described using a variety of if-then statements. • Each conditional statement has a converse, an inverse, and a contrapositive.	**Vocabulary:** conditional, hypothesis, conclusion, truth value, negation, converse, inverse, contrapositive, equivalent statements	• Recognize conditional statements and their parts. • Write converses, inverses, and contrapositives of conditionals.	**Common Core Problems:** #3,4, 28, 29, 30, 31, 39, 43, 44, 45 **Thinking Map:** Tree Map with various conditional and related conditional statements.
2 Days (Sept 13th & 14th)	**Lesson 2-3: Biconditionals and Definitions** SMP: 2,6,7 (pp. 98-104) G-CO 9	**Focus Questions:** • What is the purpose of a definition, and how can we determine if that definition is good? **Inquiry Question:** **2-3** Solve It! pg. 98 **CC** pg. 102 #32	• A definition is good if it can be written as a biconditional. • Every biconditional can be written as two conditionals that are converses of each other.	**Vocabulary:** biconditional	• Write biconditional statements. • Determine the validity of a definition.	**Common Core Problems:** #4,5,6, 30, 31, 32, 33, 39-42, 43-46, 47, 48 **Thinking Map:** Flow Map to create a Biconditional Statement.

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
2 Days (Sept. 15th & 16th)	**Lesson 2-4: Deductive Reasoning** SMP: 1,2,3,4 (pp. 106-112) **G-CO 9**	**Focus Questions:** • What elements make an argument logical? **Inquiry Questions:** **2-4** Solve It! pg. 106 How can you convince your friends that your favorite soccer team is the best? What elements are important? How can you determine if a school rule (no chewing gum) is good? What is a good argument for it and against it?	• Given true statements, deductive reasoning can be used to make a valid or true conclusion. • Deductive reasoning often involves the Laws of Syllogism and Detachment.	**Vocabulary:** deductive reasoning, Law of Detachment, Law of Syllogism, sound or logical arguments	• Use the Law of Detachment and the Law of Syllogism to draw logical conclusions from statements. • Construct arguments using the deductive structure which include the Laws of Syllogism and Detachment.	**Common Core Problems:** #4, 5, 18, 30, 31 **STEM Problems:** #11, 25, 32 **Thinking Map:** One-sided Multi-Flow Maps for the conditions that must be met for the Laws of Detachment and Syllogism.
2 Days (Sept. 19th & 20th)	**Lesson 2-5: Reasoning in Algebra and Geometry** SMP: 1,3 (pp. 113-119) **G-CO 9**	**Focus Questions:** • How can we organize a written argument? • How do we write and justify a series of logical steps to reach a conclusion? **Inquiry Question:** **2-5** Solve It! pg. 113	• Logical reasoning from one step to another is essential in building a proof. • Reasons in a proof include given information, definition, properties, postulates, and previously proven theorems.	**Vocabulary:** Reflexive Property, Symmetric Property, Transitive Property, proof, two-column proof	• Connect reasoning in algebra and geometry. • Use the two-column format to write deductive proofs using algebraic properties.	**Common Core Problems:** #4, 13, 20, 21, 22, 23, 24, 25, 26 **Thinking Map:** Tree Map for Properties of Equality and the Properties of Congruence.
1 Day (Sept. 21st)	**Topic 2 Performance Task (p. 128)**					
2 Days (Sept. 22nd & 23rd)	**Lesson 2-6: Proving Angles Congruent** SMP: 1,3,4,6 (pp. 120-127) **G-CO 9**	**Focus Questions:** • What are some ways that we can prove two angles are congruent? **Inquiry Question:** **2-6** Solve It! p.g 120	• Given information, definitions, properties, postulates, and previously proven theorems can be used as reasons in a proof.	**Vocabulary:** theorem, paragraph proof, Vertical Angles Theorem, Congruent Supplements Theorem, Congruent Complements Theorem	• Prove and apply theorems about angles. • Use two-column and paragraph proofs formats to write deductive proofs proving angles are congruent.	**Common Core Problems:** #3,4,5, 12,13, 14, 15, 18, 19, 23, 24, 25, 30, 31, 32, 33-35 **Recommended Problems:** pg. 122 Problem #2, pg. 123 Problem #3

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
1 day (Sept. 26th)	**Review Topic 2 Concepts & Skills** Use Textbook Resources and/or Teacher Created Items					
2 days (Sept. 27th & 28th)	**Topic 2 Assessment** (Created and provided by PUSD)					

Common Core Practices

- ☐ Instruction in the Standards for Mathematical Practices
- ☐ Use of Talk Moves
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