## Unit Goals – Stage 1

**Number of Days:** 24 days  
9/5/17 – 10/6/17

**Unit Description:** In Unit 1, students learn to precisely define essential geometric terms. Using this vocabulary, students find length, area, and angle measures synthetically, on the coordinate plane, and algebraically. While students should be constructing logical arguments throughout their careers in mathematics, Unit 1 focuses on introducing the students to the process of formal reasoning known as “writing a proof.” Making connections with algebra from previous courses, students solve equations giving justifications for each step. Students are given a choice of proof formats (two-column, flowchart, and paragraph) and begin using inductive and deductive reasoning.

**Materials:** Patty paper, straight edges, compasses, dynamic software (Desmos, Geogebra)

<table>
<thead>
<tr>
<th>Standards for Mathematical Practice</th>
<th>Transfer Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMP 1 Make sense of problems and persevere in solving them.</td>
<td>Students will be able to independently use their learning to...</td>
</tr>
<tr>
<td>SMP 2 Reason abstractly and quantitatively.</td>
<td>• Make sense of never-before-seen problems and persevere in solving them.</td>
</tr>
<tr>
<td>SMP 3 Construct viable arguments and critique the reasoning of others.</td>
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<tr>
<td>SMP 4 Model with mathematics.</td>
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<tr>
<td>SMP 5 Use appropriate tools strategically.</td>
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<tr>
<td>SMP 6 Attend to precision.</td>
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<tr>
<td>SMP 7 Look for and make use of structure.</td>
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<tr>
<td>SMP 8 Look for and express regularity in repeated reasoning.</td>
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**Standards for Mathematical Content Clusters Addressed**

| [s] G-CO.A | Experiment with transformations in the plane. |
| [m] G-CO.C | Prove geometric theorems. |
| [s] G-CO.D | Make geometric constructions. |
| [m] G-GPE.B | Use coordinates to prove simple geometric theorems algebraically. |
| [m] G-MG.A | Apply geometric concepts in modeling situations. |

**Making Meaning**

**UNDERSTANDINGS**

Students will understand that...

- Accurate definitions of essential geometric terms lead to precise communication.
- Points, lines, and planes are the foundations of geometry.
- Valid inductive and deductive reasoning are used to construct viable arguments.

**ESSENTIAL QUESTIONS**

Students will keep considering...

- Why are point, line, and plane the undefined terms of geometry?
- How do you use the basic ideas of points, lines and distance along a line to build the vocabulary of geometry?
- How are properties of geometric figures related to their measurable attributes?
- How are the foundations of logical reasoning used to develop and prove conjectures?
- How does logical reasoning facilitate understanding geometric relationships?

**Acquisition**

**KNOWLEDGE**

Students will know...

- Precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, and distance along a line.
- The difference between inductive and deductive reasoning.
- The connection between algebraic reasoning and geometric proofs.

**SKILLS**

Students will be skilled at and/or be able to...

- Find segment lengths using the Ruler Postulate, the Segment Addition Postulate, midpoints, segment bisectors, and the Distance Formula.
- Classify polygons and angles.
- Use coordinates to find perimeter and area.
- Bisect segments and angles.
- Make formal geometric constructions with a variety of tools.
- Write conditional and biconditional statements.
- Use inductive and deductive reasoning to construct a viable argument.
- Use properties of equality to justify the steps in solving equations and to find segment lengths and angle measures.
- Write two-column, flowchart, and paragraph proofs.
## Standards for Mathematical Practice

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## Standards for Mathematical Content

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<tr>
<td>[s] G-CO.A</td>
<td><strong>Experiment with transformations in the plane.</strong></td>
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<tr>
<td>G-CO.1</td>
<td>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, and distance around a circular arc.</td>
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<tr>
<td>[m] G-CO.C</td>
<td><strong>Prove geometric theorems.</strong> [Focus on validity of underlying reasoning while using variety of ways of writing proofs]</td>
</tr>
<tr>
<td>G-CO.9</td>
<td>Prove theorems about lines and angles. <em>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.</em></td>
</tr>
<tr>
<td>[s] G-CO.D</td>
<td><strong>Make geometric constructions.</strong></td>
</tr>
<tr>
<td>G-CO.12</td>
<td>Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). <em>Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.</em></td>
</tr>
<tr>
<td>[m] G-GPE.B</td>
<td><strong>Use coordinates to prove simple geometric theorems algebraically.</strong> [Include distance formula; relate to Pythagorean theorem]</td>
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<tr>
<td>G-GPE.7</td>
<td>Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. *</td>
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<tr>
<td>[m] G-MG.A</td>
<td><strong>Apply geometric concepts in modeling situations.</strong></td>
</tr>
<tr>
<td>G-MG.1</td>
<td>Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*</td>
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**Key:** [m] = major clusters; [s] = supporting clusters; [a] = additional clusters

* Indicates a modeling standard linking mathematics to everyday life, work, and decision-making
## Unit Assessment

### Claim 1: Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.

Concepts and skills that may be assessed in Claim 1:

- **G-CO.A**
  - Students will know precise definitions of geometric terms.
  - Students will use geometric terms precisely.

- **G-CO.C**
  - Students will prove geometric theorems about lines and angles, such as: vertical angles are congruent.

- **G-CO.D**
  - Students will make formal constructions such as copying or bisecting a segment or angle.
  - Students will use a variety of tools (compass and straightedge, patty paper) to make constructions.

- **G-GPE.B**
  - Students will use coordinates to compute perimeters of polygons.
  - Students will use the midpoint and distance formulas to solve for the measures in a geometric figure.

- **G-MG.A**
  - Students will use geometric shapes, measures and properties to solve real-world problems.

### Claim 2: Students can solve a range of well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies.

**Claim 3:** The student can clearly and precisely construct viable arguments to support their own reasoning and critique the reasoning of others.

Standard clusters that may be assessed in Claim 3:

- **G.CO.A**
- **G.CO.C**

### Claim 4: The student can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

Standard clusters that may be assessed in Claim 4:

- **G-MG.A**

## Other Evidence

### Formative Assessment Opportunities

- Informal teacher observations
- Checking for understanding using active participation strategies
- Exit slips/Summaries
- Tasks

Access [Using Formative Assessment for Differentiation](#) for suggestions. Located on the LBUSD website – “M” Mathematics – Curriculum Documents
## Learning Plan – Stage 3

### Suggested Sequence of Key Learning Events and Instruction

<table>
<thead>
<tr>
<th>Days</th>
<th>Learning Target</th>
<th>Expectations</th>
<th>Big Ideas Math Geometry (Activities and Lessons)</th>
<th>Supplemental Resources</th>
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</table>
| 2 days | I will explore writing a valid argument by participating in the Opening Task. | OPENING TASK – Dear Mom and Dad… 
This Opening Task begins with the students brainstorming in small groups about requests they recently made of an adult. Each student is asked to construct an “argument” as to why the request should be granted, first in 2-column form, then in paragraph form. This letter will be revisited at the end of the unit to see if studying the structure of proof had any effect on the students’ ability to argue for their cause. This task is a gateway into the entire vocabulary and reasoning unit. | | Application: 
• Dear Mom and Dad… |
| 4-5 days | I will define the characteristics of two-dimensional figures by… | • Knowing precise definitions of terms which are based on the undefined notions of point, line, and distance along a line. (SMP 3, 6) 
• Using dynamic software (Desmos or Geogebra) to explore geometric relationships. (SMP 5) 
• Copying, constructing and comparing segments and angles. (SMP 5) 
• Using the Ruler and Segment Addition Postulates. 
• Finding segment lengths using midpoint and segment bisectors. 
• Answering questions such as… 
  o What tools can you use to visualize geometry concepts? 
  o What are the intersection possibilities for two lines? Two planes? A line and a plane? 
  o How can you measure a line segment? 
  o How can you construct a line segment? 
  o How can you find the midpoint and length of a line segment in a coordinate plane? 
  o Can a segment have more than one perpendicular bisector? | • Section 1.1 
• Section 1.2 
• Section 1.3 | Conceptual Understanding: 
• Mathematics Vision Project: Go the Distance 
• Which One Doesn’t Belong? |
| | | | Procedural Skills and Fluency: 
• MathOpen Ref: Constructions 
• Quizlet: Basic Geometry Vocabulary 
• Illustrative Mathematics: Triangle Perimeters 
• Illustrative Mathematics: Bisecting an Angle 
• Khan Academy: Introduction to Euclidean Geometry 
• Khan Academy: Lines, Line Segments, and Rays |
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|      | I will solve for the characteristics of planes and angles by… | • Classifying polygons.  
• Finding perimeters and areas of polygons in the coordinate plane. (SMP 5)  
• Measuring, classifying, and bisecting angles. (SMP 6)  
• Using the Angle Addition Postulate to find angle measures.  
• Identifying complementary and supplementary angles.  
• Identifying linear pairs and vertical angles.  
• Answering questions such as…  
  o How can you find the perimeter and area of a polygon in a coordinate plane?  
  o How can you tell the difference between linear measure and the measure of an area?  
  o How can you measure and classify an angle?  
  o How can you describe an angle pair relationship?  
  o How can the description of an angle pair relationship help you to find angle measures?  
  o What is the difference between supplementary and complementary angles, and linear pairs? | • Section 1.4  
• Section 1.5  
• Section 1.6  
• STEM Video: Amarillo Bridge | • Khan Academy: Dividing Line Segments  
• Khan Academy: Measuring and Drawing Angles  
• Khan Academy: Pythagorean Theorem and Distance Between Points  
• Khan Academy: Distance and Midpoint |
| 4-5 days | I will begin the process of writing a proof by… | • Writing conditional and biconditional statements. (SMP 3)  
• Using definitions written as conditional statements. | • Section 2.1  
• Section 2.2  
• STEM Video: Tiger  
• Section 2.3 | Conceptual Understanding:  
• Which One Doesn’t Belong? - Shapes  
Procedural Skills and Fluency:  
• Khan Academy: Properties of Shapes  
• Khan Academy: Area  
• Khan Academy: Angles  
Application:  
• Performance Task: Horse Stalls  
• STEM Performance Task: Building Bridges |
### Learning Plan – Stage 3

#### Suggested Sequence of Key Learning Events and Instruction

| Days | Learning Target | Expectations | Big Ideas Math  
Geometry (Activities and Lessons) | Supplemental Resources |
|------|-----------------|--------------|----------------------------------|------------------------|
| 2-3 days | I will check my understanding of conditional statements by participating in the FAL. | • Constructing truth tables.  
• Using inductive and deductive reasoning. (SMP 3)  
• Identifying postulates using diagrams.  
• Sketching and interpreting diagrams. (SMP 6)  
• Answering questions such as…  
  o Why is it important to distinguish correct logic from logic that is flawed?  
  o When is a conditional statement true or false?  
  o When are equations equivalent? When are statements equivalent?  
  o Are all definitions biconditional?  
  o What is the difference between deductive and inductive reasoning?  
  o How much information is needed to determine a pattern?  
  o In a diagram, what can be assumed?  
  o In a diagram, what needs to be labeled? Capital letters? Lower-case letters? Italics? | • NCTM Illuminations: Euler Diagrams and Logic  
• STEM Performance Task: Reasoning at the Zoo  
• Week of Inspirational Math: Conjectures, Creativity and Uncertainty 9-12 |

**FORMATIVE ASSESSMENT LESSON**  
• Creating Conditional Statements

| 4-5 days | I will use algebraic and geometric reasoning to begin writing proofs by… | • Using algebraic properties of equality and the distributive property to justify the steps used in solving an equation. (SMP 6)  
• Writing two-column, flowchart, and paragraph proofs to prove geometric relationships. (SMP 3)  
• Naming and proving properties of congruence. (SMP 3)  
• Answering questions such as…  
  o How can algebraic properties help you solve an equation? | • Section 2-4  
• Section 2-5  
• Section 2-6 |

**Conceptual Understanding:**  
• Mathematics Vision Project: Cafeteria Actions and Reactions  
• Three-Act Lesson: Best Midpoint

**Procedural Skills and Fluency:**  
• Proof Vocabulary Flashcards  
• Teaching Students’ First Two-Column Proof  
• Digit Place Game  
• Khan Academy: Inductive and Deductive Reasoning
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<td>o How can you prove a mathematical statement?</td>
<td>Performance Task: Induction and the 3-D Midpoint</td>
<td>• Performance Task: Induction and the 3-D Midpoint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o How is a theorem different from a postulate?</td>
<td>Illustrative Mathematics: Midpoint Miracle</td>
<td>• Illustrative Mathematics: Midpoint Miracle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o What are the different proof formats? What is the advantage of using each of the different formats?</td>
<td>MathOpenRef: Midpoint of a Line Segment</td>
<td>• MathOpenRef: Midpoint of a Line Segment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Is the converse of a postulate always true?</td>
<td>PBS Learning Media: Distance Formula</td>
<td>• PBS Learning Media: Distance Formula</td>
</tr>
<tr>
<td>1-2 days</td>
<td>I will prepare for the unit assessment on basic geometry skills by...</td>
<td>• Incorporating the Standards for Mathematical Practice (SMPs) along with the content standards to review the unit.</td>
<td>Khan Academy: Angles</td>
<td>• Khan Academy: Angles</td>
</tr>
<tr>
<td>1-2 days</td>
<td>Unit Assessment Unit Assessment</td>
<td>Students will take the Synergy Online Unit Assessment. Unit Assessment Resources (Word or PDF) can be used throughout the unit.</td>
<td>Khan Academy: Proofs of General Theorems that Use Triangle Congruence</td>
<td>• Khan Academy: Proofs of General Theorems that Use Triangle Congruence</td>
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