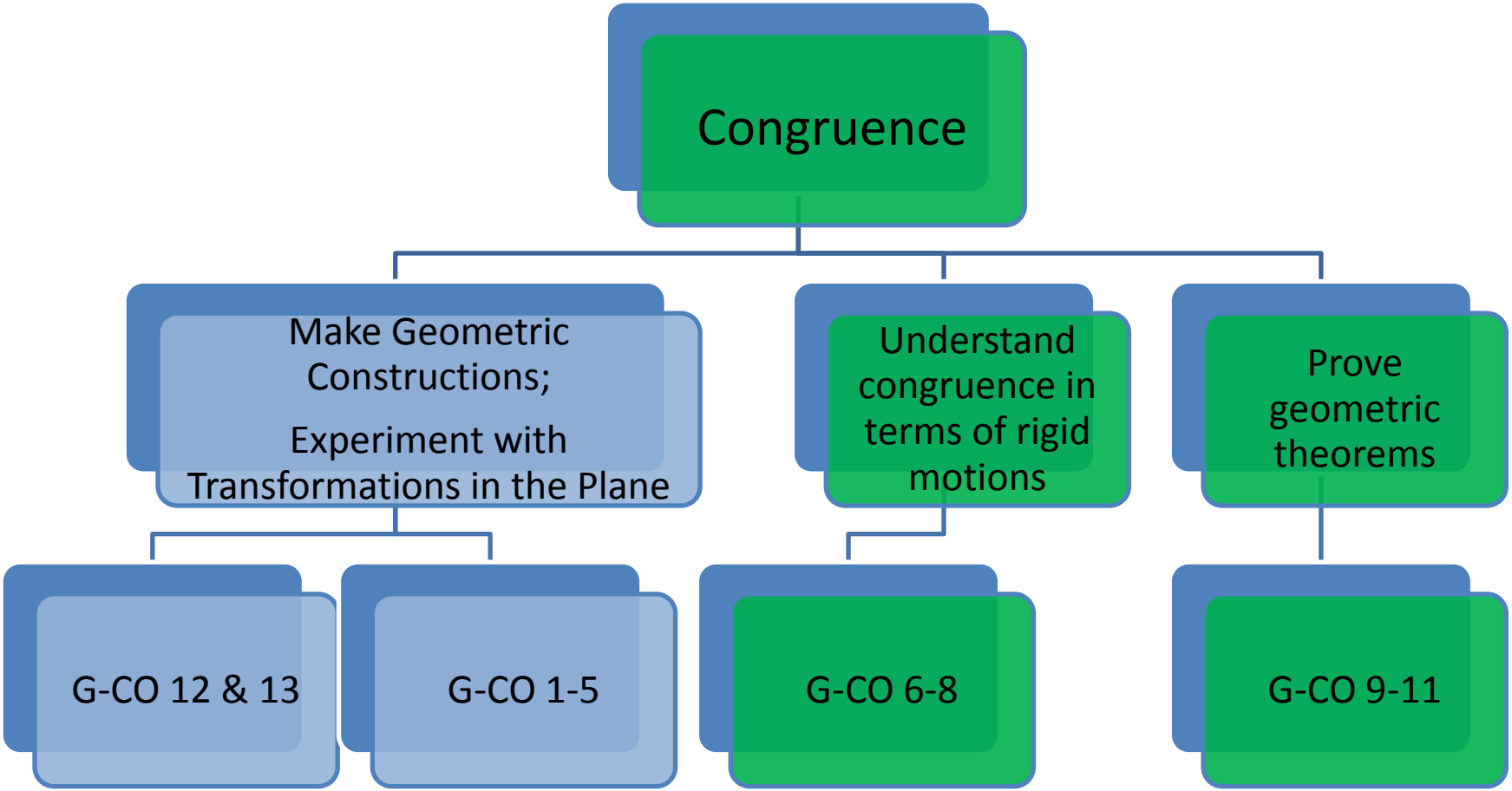
High School Geometry

Unit 1

G-MG 1-3: Modeling with Geometry: Apply geometric concepts in modeling situations



Key: Major Clusters; Supporting Clusters; Additional Clusters

High School Geometry – Unit 1

Develop the ideas of congruence through constructions and transformations

Critical Area: In this Unit the notion of two-dimensional shapes as part of a generic plane (the Euclidean Plane) and exploration of transformations of this plane as a way to determine whether two shapes are congruent or similar are formalized. Students use transformations to prove geometric theorems. The definition of congruence in terms of rigid motions provides a broad understanding of this notion, and students explore the consequences of this definition in terms of congruence criteria and proofs of geometric theorems. Students develop the ideas of congruence and similarity through transformations.

CLUSTERS	COMMON CORE STATE STANDARDS
Make geometric construction *Make a variety of formal geometric constructions using a variety of tools.*	**Geometry - Congruence** **G.CO.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software etc. 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 give line through a point not on the line. **G.CO.13** Construct an equilateral triangle, a square, a regular hexagon inscribed in a circle.
Experiment with transformations in the plan *Develop precise definitions of geometric figures based on the undefined notions of point, line, distance along a line and distance around a circular arc.* *Experiment with transformations in the plane.*	**Geometry - Congruence** **G.CO.1** Know precise definitions of angle, circle, perpendicular lines, parallel lines, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. **G.CO.2** Represent transformations in the plane using e.g. transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g. translation versus horizontal stretch.) **G.CO.3** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. **G.CO.4** Develop definitions of rotations, reflections, and translations in terms of angles, circles perpendicular lines, parallel lines, and line segments. **G.CO.5** Given a geometric figure and a rotation, reflection or translation, draw the transformed figure using e.g. graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
Understand congruence in terms of rigid motions *Use rigid motion to map corresponding parts of congruent triangle onto each other.* *Explain triangle congruence in terms of rigid motions.*	**Geometry - Congruence** **G.CO.6** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. **G.CO.7** Use definition of congruence in terms of rigid motions to show that two triangles are congruent if

CLUSTERS	COMMON CORE STATE STANDARDS
	and only if corresponding pairs of sides and corresponding pairs of angles are congruent. **G.CO.8** Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow the definition of congruence in terms of rigid motions.
Prove geometric theorems Prove theorems about lines and angles, triangles; and parallelograms.	**Geometry - Congruence** **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. **G.CO.10** Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point. **G.CO.11** Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent; the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.
MATHEMATICAL PRACTICES	
1. Make sense of problems and persevere in solving them. **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** 8. Look for and express regularity in repeated reasoning.	As you begin the year, it is advised that you start with MP1 and MP 3 to set your expectations of your classroom. This will help you and your students become proficient in the use of these practices. All other practices may be evident based on tasks and classroom activities.
LEARNING PROGRESSIONS	

(m)Major Clusters – area of intensive focus where students need fluent understanding and application of the core concepts.

(s)Supporting/Additional Clusters – designed to support and strengthen areas of major emphasis/expose students to other subjects.

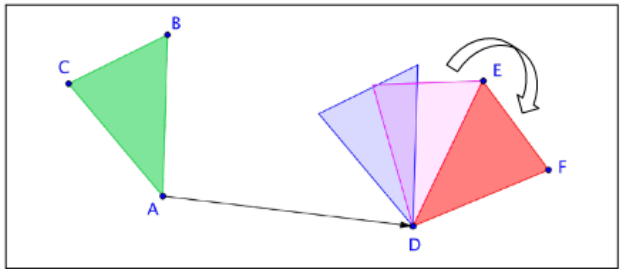
★Indicates a modeling standard linking mathematics to everyday life, work, and decision-making.

(+) Indicates additional mathematics to prepare students for advanced courses.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
• The fundamental tools of classic construction are the	• How do geometric constructions relate to	• alternate Interior Angles

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
compass and the straightedge but, there are many other tools useful for constructions including; string, reflective devices, protractor, and geometric software. • Geometric construction is a visual representation of geometric principals and develops a deeper understanding of the spatial relationships between pairs of figures and their elements. • Transformations include a variety of motions that take a set of points in the plane as input and gives us other points as output. • There are rigid transformations that preserve distance and angles and non-rigid transformations that do not. • The properties of transformations that are rigid motion can be used to identify and prove congruence of figures in a plane. • Constructing a viable argument using the precise vocabulary of transformations and congruence to prove geometric theorems in a variety of formats is important to Geometry proof.	geometric to geometric reasoning and proof? • What are the justifications that can be used to guide geometric constructions? • What are the criteria that can be used by a geometry student to select the most appropriate tools and software for geometric constructions? • What are the similarities and differences among the various transformations and how can they be grouped as either rigid or non-rigid? • How can the properties of rigid motion be used to prove that two triangles are congruent (ASA, SAS, SSS)? • What are the various pathways to create a valid proof for theorems about lines, angles, triangles congruence and parallelograms?	• compass • congruence • construction • corresponding • distance • equilateral Triangle • isosceles Triangle • mapping • median • midpoint • non-rigid motion • parallel Lines • parallelogram • perpendicular Lines • protractor • reflection • rigid Motion • rotation • straightedge • transformations • translation • vertical Angles

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
LAUSD Adopted Textbooks and Programs • Big Ideas Learning - Houghton Mifflin Harcourt, 2015: Big Ideas Geometry • College Preparatory Mathematics, 2013: Core Connections, Geometry • The College Board, 2014:Springboard Geometry **Materials:** For Students: compass, protractor, straight-edge, string, reflective devices, tracing paper, graph paper and geometric software.	Engage students to investigate more closely the definition that shapes are congruent when they "have the same size and shape." Earlier, students experimented with transformations in the plane, but now, students build more precise definitions for the rigid motions (rotation, reflection, and translation) based on previously defined and understood terms, such as point, line, between, angle, circle, perpendicular, etc. (G-CO.1,3,4). Help students strengthen their understanding of these definitions by transforming figures using patty paper,	**Formative Assessment** PARCC - http://www.parcconline.org/samples/mathematics/high-school-mathematics http://www.parcconline.org/sites/parcc/files/PARCC_SampleItems_Mathematics_HSGeoMathIIIGeometricConnection_081913_Final_0.pdf

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
For instruction: Document camera, LCD projector, screen **Websites**: Math Open Reference http://mathopenref.com/tocs/constructionstoc.html (online resource that illustrates how to generate constructions) Math is Fun http://www.mathsisfun.com/geometry/constructions.html H-G.CO.12, 13 Manga High http://www.mangahigh.com/en_us/games/transtar **Engage New York** http://www.engageny.org/sites/default/files/resource/attachments/geometry-m1-teacher-materials.pdf	transparencies, or geometry software, (G-CO.2, 3,5, MP.). Transformations should be investigated both in a general plane as well as on a coordinate system especially when explicitly describing transformations using precise names of points, translation vectors, and lines of symmetry or reflection. **Concrete Models** – Students make use of visual tools for representing geometric figures, such as simple patty paper or transparencies, graph paper, calculators, reflective devices, dynamic geometry software, or other manipulatives as they work through transformations. Have students show using rigid motions that congruent triangles have congruent corresponding parts, and that, conversely, if the corresponding parts of two triangles are congruent, then there is a sequence of rigid motions that takes one triangle to the other. For example:  Illustration of the reasoning that corresponding parts being congruent implies triangle congruence, in which point A is translated to D, the resulting image of Δ ABC is rotated so as to place B onto E, and finally, the image is then reflected along line segment DE to match point C to F. **Geometry Construction** – Students use a variety of tools and methods to make formal geometric constructions, such as: 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	**LAUSD Assessments** The district will be using the SMARTER Balanced Interim Assessments. Teachers would use the Interim Assessment Blocks (IAB) to monitor the progress of students. Each IAB can be given twice to show growth over time. **State Assessments** California will be administering the SMARTER Balance Assessment as the end of course for grades 3-8 and 11. There is no assessment for Algebra 1. The 11th grade assessment will include ítems from Algebra 1, Geometry, and Algebra 2 standards. For examples, visit the SMARTER Balance Assessment at: http://www.smarterbalanced.org/ Sample Smarter Balanced Items: http://sampleitems.smarterbalanced.org/itempreview/sbac/index.htm

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
	line parallel to a given line through a point not on the line. Teachers should use a variety of strategies for engaging students in understanding and writing proofs, including: using ample pictures to demonstrate results and generate strategies; using patty paper, transparencies, or dynamic geometry software to explore the steps in a proof; creating flow charts and other organizational diagrams for outlining a proof; and writing step-by-step or paragraph formats for the completed proof (MP.5).	

LANGUAGE GOALS for **low achieving, high achieving, students with disabilities and English Language Learners**
• Students justify congruency statements using key vocabulary, such as: mapping, translation, reflection, rotation, rigid motion, and congruence. • Students describe their understanding of a construction using key vocabulary, such as: bisect an angle, perpendicular bisector, and parallel lines. • Students identify words in word problems that help them formulate arguments and evaluate arguments to make specific claims about congruence; they will use the sentence starter, "The words _____ and _____lead me to believe…" • Students compare two geometric shapes using comparative adjectives. • Students will compare transformations in the plane and describe their changes using academic language and complete sentences.
PERFORMANCE TASKS
Circles in Triangles http://map.mathshell.org/materials/tasks.php?taskid=256#task256 http://map.mathshell.org/materials/tasks.php?taskid=258#task258

DIFFERENTIATION📖		
UDL/FRONT LOADING	ACCELERATION	INTERVENTION
Know the basic properties of the different types of triangles (equilateral, equiangular, isosceles, right angle, scalene, obtuse, acute). Work with construction tools: drawing circles, measuring with compass, drawing lines. Know how to name angles, points, lines, rays,	Students can learn to prove and develop theorems for transformations that are not on the coordinate plane using conditional statements in their explanations. Condense the units of circles and transformations together; use the properties of circles to determine points of rotation.	Model and review constructions (online resources). Include and use vocabulary lists with visual aids. Use heterogeneous groups for peer assistance and modeling.
FRONT LOADING	ACCELERATION	INTERVENTION
segments and length. Know distance, midpoint and slope formulae. Know how to plot points.	Combine dilations and similarity, showing parallelism, angle congruence in dilated figures and the definition of dilation to prove shapes are similar through AA. Make use of isosceles triangle and third angles theorems.	

References:

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