Plainfield Public Schools
Mathematics
Unit Planning Organizer

Grade/Course	Geometry
Unit of Study	Unit 2 Similarity
Pacing	7 weeks including 2 weeks for reteaching or enrichment

Standards for Mathematical Practices
MP1. Make sense of problems and persevere in solving them. MP2. Reason abstractly and quantitatively. MP3. Construct viable arguments and critique the reasoning of others. MP4. Model with mathematics. MP5. Use appropriate tools strategically. MP6. Attend to precision. MP7. Look for and make use of structure. MP8. Look for and express regularity in repeated reasoning.

Hyperlinks are noted underlined in italics.

UNIT STANDARDS
G.SRT.1Verify experimentally the properties of dilations given by a center and a scale factor. ● **A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.** ● **The dilation of a line segment is longer or shorter in the ratio given by the scale factor.** **G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.** **G.SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.** **G.SRT.4 Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.** **G.CO.C.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.C.11Prove 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.**

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"Unwrapped" Skills (students need to be able to do)	"Unwrapped" Concepts (students need to know)	DOK Levels
FOCUS STANDARD: **G.SRT.A.1 Verify experimentally the properties of dilations given by a center and a scale factor:** ● **G.SRT.A.1.A A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.** ● **G.SRT.A.1.B The dilation of a line segment is longer or shorter in the ratio given by the scale factor**		
Verify	Dilation	1

"Unwrapped" Skills (students need to be able to do)	"Unwrapped" Concepts (students need to know)	DOK Levels
FOCUS STANDARD: **G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.**		
use explain	similarity similarity	2 2

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"Unwrapped" Skills (students need to be able to do)	"Unwrapped" Concepts (students need to know)	DOK Levels
FOCUS STANDARD: G.SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.		
Use	Similarity	2

"Unwrapped" Skills (students need to be able to do)	"Unwrapped" Concepts (students need to know)	DOK Levels
FOCUS STANDARD: G.SRT.4 Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.		
Prove	Triangles Parallel lines, Pythagorean Theorem	**3**

"Unwrapped" Skills (students need to be able to do)	"Unwrapped" Concepts (students need to know)	DOK Levels
FOCUS STANDARD: G.CO.C.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.		
Prove	Lines angle	4

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"Unwrapped" Skills (students need to be able to do)	"Unwrapped" Concepts (students need to know)	DOK Levels
FOCUS STANDARD: **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.**		
Prove	Triangles	**3**

"Unwrapped" Skills (students need to be able to do)	"Unwrapped" Concepts (students need to know)	DOK Levels
FOCUS STANDARD: **G.CO.C.11Prove 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.**		
Prove	Parallelogram	4

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II. Mathematical Standards & Practices ……Explanations and Examples

Standards *Students are expected to:*	*Mathematical Practices*	*Explanations and Examples*
HS.G-SRT.A.1. Verify experimentally the properties of dilations given by a center and a scale factor:	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.5*. Use appropriate tools strategically.	Dilation is a transformation that moves each point along the ray through the point emanating from a fixed center, and multiplies distances from the center by a common scale factor. Students may use geometric simulation software to model transformations. Students may observe patterns and verify experimentally the properties of dilations.
a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.		
b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.		
HS.G-SRT.A.2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all	*HS.MP.3*. Construct viable arguments and critique the reasoning of others. *HS.MP.5*. Use appropriate tools strategically. *HS.MP.7*. Look for and make use of structure.	A similarity transformation is a rigid motion followed by dilation. Students may use geometric simulation software to model transformations and demonstrate a sequence of transformations to show congruence or similarity of figures.

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corresponding pairs of sides.		
HS.G-SRT.A.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	*HS.MP.3*. Construct viable arguments and critique the reasoning of others.	
HS.G-SRT.B.4. Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity*	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5*. Use appropriate tools strategically.	Students may use geometric simulation software to model transformations and demonstrate a sequence of transformations to show congruence or similarity of figures.

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HS.G-CO.C.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.*	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically.	Students may use geometric simulations (computer software or graphing calculator) to explore theorems about lines and angles.
HS.G-CO.C.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.*	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically.	Students may use geometric simulations (computer software or graphing calculator) to explore theorems about triangles.

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HS.G-CO.C.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.	*HS.MP.3. Construct viable arguments and critique the reasoning of others.* *HS.MP.5. Use appropriate tools strategically.*	Students may use geometric simulations (computer software or graphing calculator) to explore theorems about parallelograms.

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III. Essential Questions ……Corresponding Big Ideas

Essential Questions	Corresponding Big Ideas
How do you write a geometric proof?	A diagram is a sophisticated mathematical device for thinking and communicating. A diagram is a built geometric artifact, with both a history- a narrative of successive construction- and a purpose. A diagram is not a picture. It needs to be interpreted: learning how to read a diagram can be like learning a new language.
Given two figures are similar, how do you find the length of a missing side?	Empirical verification is an important part of the process of proving, but it can never, by itself, constitute a proof. Geometry uses a wide variety of kinds of proofs.
How do you identify a similarity transformation in a plane?	The processes of proving include a variety of activities, such as developing conjectures, considering the general case, exploring with examples, looking for structural similarities across cases, and searching for counterexamples.
How can similarity and congruence be used to solve problems and/or prove statements about or properties of triangles?	Making sense of others' arguments and determining their validity are proof-related activities. A proof can have many different valid representational forms, including narrative, picture, diagram, two-column presentation, or algebraic form.
	Underlying any geometric theorem is an invariance- something that does not change while something else does.
	Similar geometric figures have angles that are congruent and segments that are proportional in length.

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	Similar geometric figures can be created by transformations. All transformations create similar geometric figures. Dilations, in particular create figures that are similar, but may not be congruent. Congruence is also similarity. It is just a more specifically defined similarity where the ratio of lengths is 1:1. *Sources:* *Ellis, A. B., Bieda, K., & Knuth, E. (2012). Developing Essential Understanding of Proof and Proving. Reston, VA: The National Council of Teachers of Mathematics, Inc.* *Pimm, D., Sinclair, N., & Skelin, M. (2012). Developing Essential Understanding of Geometry. Reston, VA: The National Council of Teachers of Mathematics, Inc.*

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IV. Student Learning Objectives

Student Learning Objectives	Concepts and Skills	*Instructional Clarification PARCC Mathematics Specification Evidence Table*	Mathematical Practices
Verify the properties of dilations given by a center and a scale factor G.SRT.1	**Concept(s):** • Dilation of a line that passes through the center of dilation results in the same line. • Dilation of a line that does not pass through the center of dilation results in a line that is parallel to the original line. • Dilation of a line segment results in a longer line segment when, for scale factor k, |k| is greater than 1. • Dilation of a line segment results in a shorter line segment when, for scale factor k, |k| is less than 1. **Students are able to:** • Perform dilations in order to verify the impact of dilations on lines and line segments. .	Verify experimentally the properties of dilations given by a center and a scale factor. a) A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. – b) The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	MP.1 MP.3 MP.5 MP.8
Use the definition of similarity in terms of similarity transformations to decide if two given figures are similar and explain, using similarity transformations, the meaning of triangle similarity.	**Concept(s):** • Similarity transformations are used to determine the similarity of two figures. **Students are able to:** • Given two figures, determine, using transformations, if they are similar.	• Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar.	MP.7

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G.SRT.2	• Explain, using similarity transformations, the meaning of similarity for triangles.		
Use the properties of similarity transformations to establish the Angle-Angle criterion for two triangles to be similar. G.SRT.3	**Concept(s):** • •Angle-Angle criterion for similarity **Students are able to:** • Explain Angle-Angle criterion and its relationship to similarity transformations and properties of triangles.		MP.3 MP.5 MP.6
Construct and explain formal proofs of theorems involving lines, angles, triangles, and parallelograms. G.CO.C.9, G.CO.C.10, G.CO.C.11	**Concept(s):** • A formal proof may be represented with a paragraph proof or a two-column proof. **Students are able to**: • Construct and explain proofs of theorems about lines and angles including: 1. Vertical angles are congruent; 2. Congruence of alternate interior angles; 3. Congruence of corresponding angles; 4. and points on a perpendicular bisector of a line segment are exactly those	• About 75% of tasks align to G.CO.9 or G.CO.10. • Theorems include but are not limited to the examples listed in standards G-CO.9,10,11. • Multiple types of proofs are allowed (e.g., two-column proof, indirect proof, paragraph proof, and flow diagrams).	MP.3 MP.6

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	equidistant from the segment's endpoints. ● Construct and explain proofs of theorems about triangles including: 1. sum of interior angles of a triangle; 2. congruence of base angles of an isosceles triangle; 3. the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; 4. and the medians of a triangle meet at a point. ● Construct and explain proofs of theorems about parallelograms including: 1. opposite sides are congruent; 2. opposite angles are congruent; 3. the diagonals of a parallelogram bisect each other; 4. and rectangles are		

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	parallelograms with congruent diagonals.		
Prove theorems about triangles.G.SRT.4	**Concept(s):** No new concept(s) introduced **Students are able to**: • construct and explain proofs of theorems about triangles including: • a line parallel to one side of a triangle divides the other two sides proportionally; • and the Pythagorean Theorem (using triangle similarity).		MP.2 MP.6
Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. G.SRT.5	**Concept(s**): • Corresponding parts of congruent triangles are congruent (CPCTC). **Students are able to:** • Prove geometric relationships in figures using criteria for triangle congruence. • Prove geometric relationships in figures using criteria for triangle congruence. • Solve problems using triangle congruence criteria (SSS, ASA, SAS, HL). • Solve problems using triangle similarity criteria (AA).	For example, find a missing angle or side in a triangle.	MP.7

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Unit Vocabulary Terms

Unit Vocabulary Terms	
Triangle	reduction
Base angles	Corresponding Parts
Congruent Figures	Arc
Right triangle	Angle-Side-Angle (ASA) Theorem
Isosceles triangle	Side-Angle-Side (SAS) Theorem
Equilateral triangle	Side-Side-Side (SSS) Theorem
Scalene triangle	Hypotenuse Leg (HL) Theorem
Equiangular triangle	base angles
Acute triangle	isometry
Obtuse triangle	Perpendicular bisector
Exterior angle	Concurrent lines
Vertex angle	
Point of concurrency	
In center	
Median	
Centroid	
Altitude	
Similar Polygon	
Scale Factor	
Corresponding Angles	
Dilation	
Similarity	
Enlargement	

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Teaching Strategies for Differentiation /Modifications

Research Based Effective Teaching Strategies	**Modifications (how do I differentiate instruction?)**	**Special Education**	**Strategies for English Language Learners**
Task /Activities that solidifies mathematical concepts Use questioning techniques to facilitate learning Reinforcing Effort, Providing Recognition Practice, reinforce and connect to other ideas within mathematics Promotes linguistic and nonlinguistic representations Cooperative Learning Setting Objectives, Providing Feedback Varied opportunities for students to communicate	**Modifications** Before or after school tutorial program Leveled rubrics Increased intervention Small groups Change in pace Calculators Extended time Alternative assessments Tiered activities/products Color coded notes Use of movements Use any form of technology **Extension:** Do an analysis of map scale using SAS or AA to prove that triangles are similar? Make adjustments to the distances on the map using angle measures as guidelines.	Change in pace Calculators Alternative assessments Accommodations as per IEP Modifications as per IEP Use graphic organizer to clarify mathematical functions for students with processing and organizing difficulties'. Constant review of math concepts to strengthen understanding of prior concepts for difficulties recalling facts. Use self-regulations strategies for student to monitor and assess their thinking and performance for difficultly attending to task Cooperative learning (small group, teaming, peer assisted tutoring) to foster communication and strengthen confidence.	*Whiteboards* *Small Group / Triads* *Word Walls* *Partially Completed Solution* *Gestures* *Native Language Supports* *Pictures / Photos* *Partner Work* *Work Banks* *Teacher Modeling* *Math Journals*

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mathematically Use technological and /or physical tools		Use technology and/or hands on devices to: clarify abstract concepts and process for: 1. Difficulty interpreting pictures and diagram. 2.difficulties with oral communications 3. Difficulty correctly identifying symbols of numeral 4.Difficulty maintaining attentions Simplify and reduces strategies / Goal structure to enhance motivation, foster independence and self-direction for: 1.Difficulty attending to task 2. Difficulty with following a sequence of steps to solution. 3.difficulty processing and organizing Scaffolding math idea/concepts by guided practice and questioning strategies' to clarify and enhance understanding of math big ideas for:	
21st Century Learning Skills: Teamwork and Collaboration Initiative and Leadership Curiosity and Imagination Innovation and Creativity Critical thinking and Problem Solving Flexibility and Adaptability Effective Oral and Written Communication Accessing and Analyzing Information			

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		1.Difficulty with process and organization 2.difficulty with oral and written communication Teacher models strategies' and think out aloud strategies to specify step by step process for 1.Difficulties processing and organization 2. Difficulty attending to tasks. Use bold numbers and/or words to draw students' attention to important information. ** Using a reduced or enlarged generated copy (technology) of a polygon, student measure and compare original to copy. Students solve for the proportionality in their perimeters and areas.	

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Instructional Resources

<table>
<tr><th colspan="3">Instructional Resources and Materials</th></tr>
<tr><th>Formative Assessment</th><th colspan="2">Print</th></tr>
<tr><td rowspan="3">Short constructed responses
Extended responses
Checks for Understanding
Exit tickets
Teacher observation
Projects
Group
Timed Practice Test – Multiple Choice & Open-Ended Questions
<u>Performance Task</u>

<u>G.SRT.A.2 ILLUSTRATIVE MATHEMATICS PERFORMANCE TASK " Similar Triangles"</u>

<u>G.CO.C.11 ILLUSTRATIVE MATHEMATICS PERFORMANCE TASK 'Midpoints of the Sides of a Parallelogram"</u></td><td colspan="2">Glencoe McGraw-Hill (2014): Geometry
● Chapter 7 Proportions and Similarity
● Chapter 4 Congruent Triangles
● Chapter 5 Relationships in Triangles
● Chapter 6 Quadrilaterals</td></tr>
<tr><td colspan="2">Technology</td></tr>
<tr><td>Resources for teachers
<u>Annenberg Learning : Insight into Algebra 1</u>
<u>Mathematics Assessment Projects</u>
<u>Get the Math</u>
<u>Achieve the Core</u>
<u>Illustrative Mathematics</u>
<u>Inside Mathmatics.org</u>
<u>Asia Pacific Economic Cooperation : :Lesson Study Videos</u>
<u>Genderchip.org</u>
<u>Interactive Geometry</u>
<u>Mathematical Association of America</u>
<u>National Council of Teachers of Mathematics</u>
<u>learner.org</u>
<u>Math Forum : Teacher Place</u>
<u>Shmoop /common core math</u>
<u>Geometer's Sketchpad</u></td><td>Resources for Students
<u>Khan Academy</u>
<u>Math world : Wolfram.com</u>
<u>Webmath.com</u>
<u>sosmath.com</u>
<u>Mathplanet.com</u>
<u>Interactive Mathematics.com</u>
<u>Mathexpression.com.algebra</u>
<u>SparksNotes :Geometry Proofs</u></td></tr>
</table>

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Additional Performance Task for classroom use: *G.SRT.A.1 Dilating a Line* *G.SRT.A.2 Are They Similar?* *G.SRT.A.3 Similar Triangles* *G.CO.C.9 Congruent Angles made by parallel lines and a transverse* *G.CO.C.9 Points equidistant from two points in the plane* *G.CO.C.10 Midpoints of Triangle Sides* *G.CO.C.10 Sum of angles in a triangle* *G.CO.C.11 Is this a parallelogram?* *G.SRT.B.4 Joining two midpoints of sides of a triangle* *G.SRT.B.4 Pythagorean Theorem* *G.SRT.B.5 Tangent Line to Two Circles* **Project (Optional)** Project Based Learning : Shadows Project GRASP		

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PPS Secondary Mathematics Curriculum: Geometry

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