

High School	Units of Study Semester 1 Geometry	Unit 1
<b>Unit 1 Basics of Constructions and Proofs: Lines and Angles</b>		
<b>Number of Instructional hours: 12 hrs</b>		
<b>Unit Overview</b>		
Points, lines, and angles are studied using the following components: definitions (beginning with very general definitions and then becoming more precise); constructions (using drawing tools and/or geometric software); proofs (beginning with informal proofs and becoming more formal as various types of proofs are studied in Unit 2); and simple use of coordinates.		
<b>Mathematical Practice Standards to Be Integrated</b>		
<u><b>3 Construct viable arguments and critique the reasoning of others.</b></u>		
Mathematically proficient students... <ul style="list-style-type: none"> <li>• understand and use stated assumptions, definitions, and previously established results in constructing arguments.</li> <li>• make conjectures and build a logical progression of statements to explore the truth of their conjectures.</li> <li>• justify their conclusions, communicate them to others, and respond to the arguments of others.</li> </ul>		
<u><b>5 Use appropriate tools strategically.</b></u>		
Mathematically proficient students... <ul style="list-style-type: none"> <li>• consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, and/or dynamic geometry software.</li> <li>• are sufficiently familiar with tools appropriate for the course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations.</li> <li>• know that technology can enable them to visualize the results of varying assumptions, explore consequences.</li> <li>• are able to use technological tools to explore and deepen their understanding of concepts.</li> </ul>		
<u><b>6 Attend to precision.</b></u>		
Mathematically proficient students... <ul style="list-style-type: none"> <li>• try to communicate precisely to others;</li> <li>• try to use clear definitions in discussion with others and in their own reasoning;</li> <li>• state the meaning of the symbols they choose, including using a congruence sign consistently and appropriately.</li> <li>• are careful about specifying units of measure to clarify the correspondence with quantities in a problem.</li> </ul>		

- have learned to examine claims and make explicit use of definitions by the time they reach high school.

### **7 Look for and make use of structure.**

Mathematically proficient students...

- recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective.
- can see complicated things, such as some geometric figures, as single objects or as being composed of several objects.

## **Essential Questions**

- *How can you convince people that a winning two-bank-shot is possible in a pool game using geometric definitions and constructions?*
- *How can a plumber use geometric principles to minimize the cost of connecting a water line from a house to the city water main?*
- *When you make a conjecture based on observations, how can you use logic to prove you are correct? How do you develop a convincing argument?*
- *How are formal geometric constructions different than drawings and sketches?*
- *How can geometric theorems be used by a carpenter when framing a house?*

## **Assessment**

<b>Task Name:</b>	<a href="#">NCTM Bank Shot</a> <a href="#">Once Upon a Time</a> <a href="#">As the Crow Flies</a>
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### **Clusters and Instructional Notes**

**Domain: Congruence**

**Cluster: Experiment with transformation in the plane.**

**Prior Knowledge:**

Students should be familiar with the theories of angle sums (7<sup>th</sup>-grade) and angles formed by parallel lines and transversals (8<sup>th</sup>-grade).

**Clarification of the Geometry Units of Study:**

Several standards are repeated throughout the units in order to develop fluency. When a standard first appears, part of the

### **Common Core State Standards**

[G-CO.A.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, and distance around a circular arc.](#) **Supporting**

standard may be stricken: the remainder is the section to be addressed. When the standard appears again, another part will be the focus, so by the end of the year all parts of the standard will be covered.

Professional Learning Communities at each school should discuss the sequence, time frame, and essential questions for each unit based on the needs of their populations. It is important, however, to prepare students for the PARCC assessment, so caution should be taken when making alterations. In addition, tasks should not be limited to those listed. Look at many sources for appropriate activities and/or share those created within the school.

**Clarification of the Standard:**

Theories of angle sums and angles formed by parallel lines and transversals are generalized and informally proven in this unit.

Students will gain a working knowledge of how to use definitions to communicate, solve problems, and support arguments.

Distances around a circular arc are covered in Unit 8.

**Integrating the Standards for Mathematical Practice:**

Some Standards for Mathematical Practice are listed as the focus for certain units because they align better. However, all Standards for Mathematical Practice are intended to be universally applied.

**6 Attend to precision.**

Use of precise definitions, along with appropriate use of symbols, is important as students begin to formulate proofs about lines and angles.

<p><b><u>Domain: Congruence</u></b></p> <p><b>Cluster: Make Geometric Constructions.</b></p> <p><b>Prior Knowledge:</b> Students used rulers and protractors to draw geometric shapes with emphasis on triangles in 4<sup>th</sup>-7<sup>th</sup> grades.</p> <p><b>Clarification of the Standard:</b> Students will demonstrate fluency when using geometric tools to make constructions of lines and angles.</p> <p><b>Integrating the Standards for Mathematical Practice:</b> <b><u>5 Use appropriate tools strategically.</u></b> Fluency with the use of constructional tools, including tracing paper and/or dynamic geometry software, helps students draft a model of a geometric phenomenon and can lead to conjectures and proofs.</p>	<p><a href="#"><u>G-CO.D.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 given line through a point not on the line.</u></a></p> <p><b>Supporting-Fluency</b></p>
<p><b><u>Domain: Congruence</u></b></p> <p><b>Cluster: Prove geometric theorems</b></p> <p><b>Prior Knowledge:</b> In 8<sup>th</sup>-grade, students used informal arguments to establish facts such as the Triangle Sum Theorem and angle congruence when parallel lines are cut by a transversal.</p> <p><b>Clarification of the Standard:</b> Students begin to formalize prior experiences by using more precise definitions and developing careful proofs using a variety of formats such as flow-chart, two-column, and paragraph proofs.</p> <p>Students will gain a clear understanding of the theorems to be used in solving problems and constructing proofs later in the</p>	<p><a href="#"><u>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.</u></a> <b>Major</b></p>

<p>course.</p> <p>The Parallel Postulate is an important topic in this unit.</p> <p><b>Integrating the Standards for Mathematical Practice:</b>  <u><a href="#">3 Construct viable arguments and critique the reasoning of others</a>, <a href="#">6 Attend to precision</a>.</u>          Students will use precise definitions in developing careful proofs.</p>	
<p><b><u>Domain: Expressing Geometric Properties with Equations</u></b></p> <p><b>Cluster: Use coordinates to prove simple geometric theorems algebraically.</b></p> <p><b>Prior Knowledge:</b>          Students should be familiar with plotting points in a coordinate plane and finding the slope of a line from Algebra 1.</p> <p><b>Clarification of the Standard:</b>          The geometry concepts should be developed by flowing between definition, construction, and proof. Some coordinate geometry standards are embedded in many units to promote fluency. Coordinate geometry will be covered in-depth in Unit 7.</p> <p>Students will find the midpoint of a segment algebraically and determine whether lines are parallel or perpendicular.</p> <p>G-GPE.4: Simple topics and theorems can be introduced through construction. Examples of these theorems include ruler postulate, protractor postulate, and vertical angles congruence theorem.</p> <p>Introduce the use of coordinate geometry with simple</p>	<p><u><a href="#">G-GPE.B.4 Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point <math>(1, \sqrt{3})</math> lies on the circle centered at the origin and containing the point <math>(0, 2)</math>.</a></u> <b>Major—Fluency</b></p> <p><u><a href="#">G-GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.</a></u> <b>Major</b></p> <p><u><a href="#">G-GPE.B.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).</a></u> <b>Major—Fluency</b></p>

<p>situations such as perimeter of rectangles. This standard will be fully covered in Unit 7.</p> <p>G-GPE.6: Students can use the midpoint formula to find the point halfway, one quarter and three quarters of the way between endpoints.</p> <p>G-GPE.5: Instead of formally proving each of these concepts, begin with introducing and informally proving them. As students become more comfortable with the concepts, proofs can be more formally developed (paragraph proof, flow proofs and two-column proofs).</p> <p><b>Integrating the Standards for Mathematical Practice:</b>  <a href="#">7 Look for and make use of structure.</a>  Students build proficiency with patterns and structures as they build a mathematical system with structural statements including postulates, algebraic properties and theorems.</p>	
<p><b>Domain: Modeling with Geometry</b>  <b>Cluster: Apply geometric concepts in modeling situations.</b></p> <p><b>Prior Knowledge:</b>  In 7<sup>th</sup> and 8<sup>th</sup>-grades, students used informal geometric constructions to solve real-world and mathematical problems involving area, surface area and volume.</p> <p><b>Clarification of the Standard:</b>  Students will identify geometric relationships stated as real-world situations and use them to solve problems. For example, How can the distance between a line and a point not on the line be interpreted as a cost-savings problem?</p> <p>Typographic grid systems refer to determining the amount of space needed in the layout of publications (e.g. yearbooks,</p>	<p><a href="#">G-MG.A.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).</a>★ Major</p>

etc.).

**Integrating the Standards for Mathematical Practice:**

**3 Construct viable arguments and critique the reasoning of others.**

Student use viable arguments and reasoning to analyze situations by breaking them down, communicating their ideas to others, then critiquing their own and other methods to determine validity.

**The standards listed below include all the CCSS-M linked to this Unit of Study. The list does not distinguish among MAJOR, SUPPORTING and ADDITIONAL standards in this Unit of Study.**

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