

## **Unit 3**

### **Problem Solving and Geometry Fundamentals**

#### **Standards**

The student will:

- 1.1 Make conjectures relating to vertical angles, complementary angles, supplementary angles, and angles formed by perpendicular lines.
- 1.2 Make conjectures related to angles and parallel lines, including alternate interior/exterior angles, and same-side interior/exterior angles.
- 1.3 Solve problems related to angles and parallel lines.
- 1.4 Determine soles of lines parallel and perpendicular to given lines.
- 2.1 Solve problems involving interior and exterior angles of triangles.
- 10.1 Recognize the hypothesis and conclusion of an if-then statement and state the converse.

**Unit 3**  
**Problem Solving and Geometric Fundamentals**

**Day 1**  
**Patterns**

**Connections**

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>Using problem solving strategies such as: looking for sub-problems, drawing diagrams, and guess and check.</li> </ul>	<ul style="list-style-type: none"> <li>Develop skills in conjecturing, explaining, and justifying.</li> </ul>	<ul style="list-style-type: none"> <li>Constructing justifications and proofs for geometric theorems.</li> </ul>

**Lesson Process**

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Launch</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-1 with teacher.</li> </ul>	<ul style="list-style-type: none"> <li>Complete PS-1 with study teams.</li> <li>Stress the importance of looking for patterns.</li> <li>Making organized table of data is one strategy to use in finding patterns.</li> </ul>	<ul style="list-style-type: none"> <li>The purpose of the problems is to establish a framework in which to teach students to think logically and to get students to justify their conclusions.</li> </ul>
<p><b>Explore</b></p> <p>20-25 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-2 through PS-5 with study team.</li> </ul>	<ul style="list-style-type: none"> <li>Start PS-2 with class.</li> <li>“Use of graph paper models of the figures in PS-2 helps students visualize the figures beyond the first few.</li> </ul>	<ul style="list-style-type: none"> <li>The sequence 1, 3, 6, ... will be referred to as the triangular numbers in consequent units.</li> <li>Demonstration of building the</li> </ul>

Steps	Student Activity	Teacher Support	Comment/Evaluation
		<ul style="list-style-type: none"> <li>• Help students analyze patterns.</li> <li>• Guide students in finding the 'difference' between two consecutive terms of each given sequence.</li> <li>• Guide students in using clear and precise language in describing the rule for each sequence.</li> <li>• A graphic interpretation, using dots, for PS-4 would help students visualize why the numbers are called the square numbers.</li> <li>• Pascal's Triangle offers opportunity for students to explore many number patterns.</li> </ul>	<p>numbers with 'dots' would help students visualize the pattern.</p> <ul style="list-style-type: none"> <li>• Pascal's Triangle will appear in the expansion of binomials.</li> </ul>
<p><b>Summarize</b> 5-10 minutes</p>	<ul style="list-style-type: none"> <li>• Share results with class.</li> </ul>	<ul style="list-style-type: none"> <li>• Select students or teams to share ideas or results with class.</li> </ul>	<ul style="list-style-type: none"> <li>• Foster a sense of completion.</li> <li>• "What did we learn TODAY?"</li> <li>• "It IS often necessary to make your own cues from the rule of the pattern."</li> <li>• "Sometime, cues that help in finding the pattern for one sequence does not help in finding the pattern for another, so it is necessary to look for details."</li> </ul>
<p><b>Homework</b></p>	<p>PS-8, PS-9, PS-11, PS-12</p>		

**Unit 3**  
**Problem Solving and Geometric Fundamentals**

**Day 2**  
**Looking for Patterns in Tables**

**Connections**

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>Find patterns for given sequences.</li> </ul>	<ul style="list-style-type: none"> <li>Develop skills in conjecturing, explaining, and justifying.</li> </ul>	<ul style="list-style-type: none"> <li>Constructing justifications and proofs for geometric theorems.</li> </ul>

**Lesson Process**

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Launch</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>Create organized tables as strategy for finding patterns.</li> </ul>	<ul style="list-style-type: none"> <li>Complete PS-13 with class.</li> <li>Emphasize the importance of making table of data as a strategy in finding patterns.</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate the placement of lines for maximum number of points of intersection.</li> </ul>
<p><b>Explore</b></p> <p>20-25 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-13 through PS-16 with study team.</li> </ul>	<ul style="list-style-type: none"> <li>Help students complete sequence of sketches prior to finding rule for the sequence.</li> <li>Monitor students' calculation for entries in data tables.</li> <li>Help students recall strategies used in finding patterns for previous sequences.</li> </ul>	<ul style="list-style-type: none"> <li><b>“When a task has lots of parts, you have to plan to do them in sequence.”</b></li> </ul>

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Summarize</b></p> <p>8-12 minutes</p>	<ul style="list-style-type: none"> <li>• Share rules and ideas related to given sequences.</li> <li>• Share strategies used to find rules.</li> </ul>	<ul style="list-style-type: none"> <li>• Select students to discuss rules and ideas related to given sequences.</li> <li>• Select students to share strategies used in finding rules for the patterns.</li> <li>• Bridge strategies used with previously used strategies.</li> <li>• <b>“Do you remember in PS-5 we ... .”</b></li> <li>• <b>“What was the purpose of making a table of data?”</b></li> </ul>	<ul style="list-style-type: none"> <li>• Discuss alternative strategies.</li> <li>• <b>“Which of the problems were the most difficult?”</b></li> </ul>
<p><b>Homework</b></p>	<p>PS-17 through PS-20</p>		

**Unit 3**  
**Problem Solving and Geometry Fundamentals**

**Day 3**  
**Finding General Terms From Patterns**

**Connections**

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>Continue pattern for given sequences.</li> </ul>	<ul style="list-style-type: none"> <li>Determine general terms for given sequences.</li> </ul>	<ul style="list-style-type: none"> <li>Make generalizations for given situations.</li> </ul>

**Lesson Process**

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Launch</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>Read PSL-13.</li> </ul>	<ul style="list-style-type: none"> <li>Read PZL-13 with class.</li> <li>Continue with finding rules for given patterns.</li> <li>Start PS-22 with class.</li> <li>Demonstrate the strategy of completing table of data.</li> </ul>	
<p><b>Explore</b></p> <p>20-25 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-22 through PS-24 with study team.</li> </ul>	<ul style="list-style-type: none"> <li>Complete PS-22 with class.</li> <li>Guide students in expressing general term as an algebraic expression.</li> <li>Guide students in making connections</li> </ul>	<ul style="list-style-type: none"> <li>Do not expect correct notation for the <math>n</math>th term at this point.</li> <li>Accept <math>n</math>th term written with</li> </ul>

Steps	Student Activity	Teacher Support	Comment/Evaluation
		with strategies used in previous problems. <ul style="list-style-type: none"> <li>• <b>“What was the process we used when we were working on PS....?”</b></li> <li>• <b>“Did the sketches help us in formulating a rule?”</b></li> <li>• <b>“How can we describe the general term?”</b></li> <li>• <b>Guide students in using clear and precise language.</b></li> </ul>	English description.
<b>Summarize</b> 10-15 minutes	<ul style="list-style-type: none"> <li>• Share ways of describing the general term for given sequences.</li> <li>• Share strategies used for finding the general term.</li> </ul>	<ul style="list-style-type: none"> <li>• Have students to share ways of describing the general r for given sequences.</li> <li>• Have students describe strategies used in finding the general terms.</li> </ul>	
<b>Homework</b>	<ul style="list-style-type: none"> <li>• PS-26, PS-27, PS-29, PS-30, PS-31</li> </ul>		

**Unit 3**  
**Problem Solving and Geometry Fundamentals**

**Day 4**  
**Rays and Angles**

**Connections**

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>Familiarity with angles.</li> </ul>	<ul style="list-style-type: none"> <li>Introduction to basic vocabulary associated with angles.</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems related to the measurement of angles.</li> </ul>

**Lesson Process**

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Launch</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-32.</li> </ul>	<ul style="list-style-type: none"> <li>Introduction and discussion of PS-32.</li> </ul>	
<p><b>Explore</b></p> <p>20-30 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-33 through PS-36 with teacher and study team..</li> </ul>	<ul style="list-style-type: none"> <li>Much of the workshop period for this lesson is devoted to teachers guided writing.</li> <li>Have students use resource page to keep track of vocabulary in this unit.</li> <li>Add the definition for ray, angle, and vertex to the tool kit.</li> </ul>	

Steps	Student Activity	Teacher Support	Comment/Evaluation
		<ul style="list-style-type: none"> <li>• Guide students in writing and naming of angles.</li> <li>• Explain the convention of using slashes to indicate congruent segments or angles.</li> <li>• Demonstrate the use of a protractor as a measuring device for angles.</li> <li>• You may choose to use an angle ruler instead of the protractor.</li> <li>• Add definition for types of angles in tool kit. Draw examples of each.</li> <li>• Demonstrated strategies for calculating measures of adjacent angles for specified conditions.</li> </ul>	<ul style="list-style-type: none"> <li>• Students from Connect Math are familiar with the use of angle rulers as a measuring device for angles.</li> </ul>
<p><b>Summarize</b> 10-15 minutes</p>	<ul style="list-style-type: none"> <li>• Start or complete PS-39 with study team.</li> </ul>	<ul style="list-style-type: none"> <li>• Start PS-39 with class.</li> </ul>	<ul style="list-style-type: none"> <li>• Strategies are discussed though the explore period.</li> </ul>
<p><b>Homework</b></p>	<p>PS-37 through PS-40.</p>		

**Unit 3**  
**Problem Solving and Geometry Fundamentals**

**Day 5**  
**Parallel Lines and Angle Relationships**

**Connections**

Prior Work	Current Bid Idea	Future Work
<ul style="list-style-type: none"> <li>Name and sketch angles and rays.</li> </ul>	<ul style="list-style-type: none"> <li>Complete conjectures relating to angle relationships for parallel lines and intersecting lines.</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems using properties related to parallel and intersecting lines.</li> </ul>

**Lesson Process**

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Launch</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-45 with teacher and study team.</li> </ul>	<ul style="list-style-type: none"> <li>Show student the symbols used, by convention, for indicating parallel lines and right angles (perpendicular lines).</li> <li>Guide students in completing PS-46.</li> </ul>	
<p><b>Explore</b></p> <p>20-25 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-47 and PS-48.</li> </ul>	<ul style="list-style-type: none"> <li>Provide students with resource page for PS-47.</li> <li>Remind students of strategies used in previous lesson on finding measures of adjacent angles.</li> <li>Make sure each team has the correct answers for PS-47 part a.</li> </ul>	<ul style="list-style-type: none"> <li>Do not talk lecture student on properties of vertical angles, corresponding angles of parallel lines, etc.</li> <li>Encourage students to make conjectures after experimentation.</li> </ul>

Steps	Student Activity	Teacher Support	Comment/Evaluation
		<ul style="list-style-type: none"> <li>• Students should make conjecture relating to the corresponding angles of parallel lines.</li> <li>• Students should make conjecture relating alternate interior angles of parallel lines.</li> </ul>	
<p><b>Summarize</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>• Take notes on PS-40.</li> </ul>	<ul style="list-style-type: none"> <li>• Complete PS-49 with class.</li> <li>• Students should be recording answers.</li> <li>• In parts d and h, the vocabulary applies, but not the conjectures.</li> <li>• Make certain the all vocabulary and conjectures are added in the tool kit.</li> </ul>	<ul style="list-style-type: none"> <li>• Some of the parts marked 'none' can be shown to be supplementary, but do not expect it here.</li> </ul>
<p><b>Homework</b></p>	<ul style="list-style-type: none"> <li>• PS-51 through PS-54.</li> </ul>	<ul style="list-style-type: none"> <li>• PS-52 is part of next lesson.</li> </ul>	

**Day 6**  
**Adjacent and Vertical Angles**

**Connections**

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>Name and sketch angles and rays.</li> </ul>	<ul style="list-style-type: none"> <li>Complete conjectures relating to angle relationships for parallel lines and intersecting lines.</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems using properties related to parallel and intersecting lines.</li> </ul>

**Lesson Process**

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Launch</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>Read PZL-14.</li> <li>Complete selected parts from PS-58 and PS-59 with teacher and class.</li> </ul>	<ul style="list-style-type: none"> <li>Read PZL-14.</li> <li>Introduction of definition for adjacent angles.</li> <li>Complete selected parts from PS-58 and PS-59 with class.</li> </ul>	
<p><b>Explore</b></p> <p>20-25 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-58 through PS-62 with study team.</li> <li>Add definition for adjacent angles and vertical angles to toolkit.</li> </ul>	<ul style="list-style-type: none"> <li>Student should understand that adjacent angles and vertical angles refer to pairs of angles.</li> <li>Guide students in checking all three conditions for determining whether pairs of angles are adjacent.</li> <li>Emphasis on PS-61 and PS-62 should be on how students know the angle relationships and the correct</li> </ul>	<ul style="list-style-type: none"> <li>Guide students in writing justifications for how they know angle relationships.</li> <li>Check for sequencing of solutions.</li> </ul>

Steps	Student Activity	Teacher Support	Comment/Evaluation
		sequencing in finding solutions.	
<b>Summarize</b> 8-10 minutes	<ul style="list-style-type: none"> <li>Share justification and sequencing of solutions for PS-61 and PS-62 with class.</li> </ul>	<ul style="list-style-type: none"> <li>Select study teams to share justifications and sequencing of solutions for PS-61 and PS-62.</li> </ul>	
<b>Homework</b>	<ul style="list-style-type: none"> <li>PS-63 through PS-66.</li> </ul>		

**Day 7**  
**Practice With Angles**

**Connections**

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>Name and sketch angles and rays.</li> </ul>	<ul style="list-style-type: none"> <li>Complete conjectures relating to angle relationships for parallel lines and intersecting lines.</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems using properties related to parallel and intersecting lines.</li> </ul>

**Lesson Process**

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Launch</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-67 with teacher and class.</li> </ul>	<ul style="list-style-type: none"> <li>Complete PS-67 with class.</li> </ul>	
<p><b>Explore</b></p> <p>20-25 minutes</p>	<ul style="list-style-type: none"> <li>Complete PS-68 through PS-72 with study group.</li> </ul>	<ul style="list-style-type: none"> <li>Consolidation of definitions and conjectures from past lessons.</li> <li>Focus on explanations is major factor.</li> <li>Students may express their explanations in brief phrases.</li> <li>Guide students to focus on geometric relationships.</li> <li>Students</li> <li>Encourage students to use toolkit for vocabulary and definitions.</li> </ul>	<ul style="list-style-type: none"> <li>Students need to understand that the problems may be completed using different conjectures in different orders.</li> <li>There is no ONE way that is THE way.</li> </ul>

<b>Steps</b>	<b>Student Activity</b>	<b>Teacher Support</b>	<b>Comment/Evaluation</b>
<b>Summary</b> 10-15 minutes	<ul style="list-style-type: none"> <li>Share explanations and justifications for PS-68 and PS-69 with class.</li> </ul>	<ul style="list-style-type: none"> <li>Select study team to share explanations and justification for PS-68 and PS-69.</li> </ul>	<ul style="list-style-type: none"> <li>These types of problems will appear for the rest of the semester. Do not stop to remediate.</li> </ul>
<b>Homework</b>	PS 73 through PS-77.		

## Day 8 Graphing Linear Inequalities

### Connections

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>Graph solutions for inequalities with one variable on the number line.</li> <li>Graph linear equations in two variables.</li> </ul>	<ul style="list-style-type: none"> <li>Graph linear inequalities in two variables.</li> </ul>	<ul style="list-style-type: none"> <li>Graph systems of linear inequalities in two variables.</li> </ul>

### Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
<b>Launch</b> 10-15 minutes	<ul style="list-style-type: none"> <li>Complete PS-78 through PS-81 with teacher.</li> </ul>	<ul style="list-style-type: none"> <li>Complete PS-78 through PS-81 with class.</li> </ul>	
<b>Explore</b> 20-25 minutes	<ul style="list-style-type: none"> <li>Complete PS-82 through PS-87.</li> </ul>	<ul style="list-style-type: none"> <li>Some students may need help in graphing linear equations.</li> </ul>	
<b>Summarize</b> 8-10 minutes	<ul style="list-style-type: none"> <li>Share conclusions for PS-86 with class.</li> </ul>	<ul style="list-style-type: none"> <li>Select study team to share conclusions for PS-86 with class.</li> </ul>	
<b>Homework</b>	PS-88 through PS91.		

## Day 9 Angles and Triangles

### Connections

Prior Work	Current Big Ideas	Future Work
Angle relationships for parallel lines.	<ul style="list-style-type: none"> <li>The sum of the measures of the interior angles of a triangle is <math>180^\circ</math>.</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems relating to measures of angles related to triangles.</li> </ul>

### Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
<b>Launch</b> 8-10 minutes	<ul style="list-style-type: none"> <li>Complete experiment PS-92 with teacher and class.</li> </ul>	<ul style="list-style-type: none"> <li>Complete PS-92 with class.</li> </ul>	
<b>Explore</b> 20-25 minutes	<ul style="list-style-type: none"> <li>Complete PS-93 with teacher and study team.</li> <li>Add Triangle Interior angle Sum Theorem to toolkit.</li> <li>Complete PS-94 with teacher and study team.</li> </ul>	<ul style="list-style-type: none"> <li>Complete PS-93 with class.</li> <li>Explain the parts (a) – (d) of PS-92 produced a sequence of true, connected facts that verified the final statement. Therefore, ‘The sum of the measure of the interior angles of a triangle is <math>180^\circ</math>’ is now a theorem rather than conjecture.</li> <li>Guide students in understanding the relationship between a given statement and its converse.</li> <li>Start of first portion of PS-94 with</li> </ul>	<ul style="list-style-type: none"> <li>The process of producing a sequence of true, connected facts that verify a final statement proves a conjecture.</li> <li>A proven conjecture is known as a theorem.</li> </ul>

<b>Steps</b>	<b>Student Activity</b>	<b>Teacher Support</b>	<b>Comment/Evaluation</b>
	<ul style="list-style-type: none"> <li>Complete PS-96 with study team.</li> </ul>	class.	
<b>Summarize</b> 8-10 minutes	Discus PS-95 with class.	<ul style="list-style-type: none"> <li>PS-95 is to stimulate discussion about cause and effect. It provides possibilities to work on logical argumentations.</li> </ul>	
<b>Homework</b>	PS-97 through PS102.		

## Day 10 Exterior Angles

### Connections

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>Complementary and supplementary angles.</li> <li>The sum of the measures of the interior angles of a triangle is <math>180^\circ</math>.</li> </ul>	<ul style="list-style-type: none"> <li>Identify exterior angles of a triangle.</li> <li>Measure of an exterior angle is equal to the sum of the measures of two remote interior angles.</li> </ul>	<ul style="list-style-type: none"> <li>Solve problems relating to measures of angles.</li> <li>Solve problems relating to parallel lines.</li> </ul>

### Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
<b>Launch</b> 10-15 minutes	<ul style="list-style-type: none"> <li>Complete PS-103 with teacher and class.</li> </ul>	<ul style="list-style-type: none"> <li>Complete PS-103 with class.</li> <li>Guide students in extending sides of triangles and identifying exterior angles.</li> <li>Identify remote interior angles.</li> </ul>	<ul style="list-style-type: none"> <li>Use counter-examples to help students find exterior angles to triangles.</li> </ul>
<b>Explore</b> 20-25 minutes	<ul style="list-style-type: none"> <li>Complete conjecture for part (b) of PS-103,</li> <li>Complete PS-104 through PS-106 with study team.</li> </ul>	<ul style="list-style-type: none"> <li>Check on conjecture for part (b) of PS-103.</li> <li>Guide students in completing PS-106.</li> </ul>	
<b>Summarize</b>	<ul style="list-style-type: none"> <li>Share conclusions for PS-106 with class.</li> </ul>	<ul style="list-style-type: none"> <li>Select study teams to share PS-106 with class.</li> </ul>	

<b>Steps</b>	<b>Student Activity</b>	<b>Teacher Support</b>	<b>Comment/Evaluation</b>
8-10 minutes			
<b>Homework</b>	<ul style="list-style-type: none"><li>• PS-108 through PS-112.</li></ul>		

**Day 11**  
**Unit Review**

**Connections**

Prior Work	Current Big Idea	Future Work
<ul style="list-style-type: none"> <li>• Angle relationship related to parallel lines.</li> <li>• Sum of measures of interior angles in a triangle.</li> <li>• Relationship of exterior angles to remote interior angles.</li> </ul>	<ul style="list-style-type: none"> <li>• Review of Unit 3.</li> </ul>	<ul style="list-style-type: none"> <li>• Solve problems related to parallel lines and triangles.</li> </ul>

**Lesson Process**

Steps	Student Activity	Teacher Support	Comment/Evaluation
<p><b>Launch</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>• Read PZL-14 and PZL-15.</li> </ul>	<ul style="list-style-type: none"> <li>• PZL-14 is from a previous section.</li> </ul>	
<p><b>Explore</b></p> <p>20-30 minutes</p>	<ul style="list-style-type: none"> <li>• Complete PS-113 through PS-122 with study team.</li> </ul>	<ul style="list-style-type: none"> <li>• Guide students in completing PS-121 and PS-122.</li> </ul>	
<p><b>Summarize</b></p> <p>10-15 minutes</p>	<ul style="list-style-type: none"> <li>• Share conclusion for PS-113 through PS-122 with class.</li> </ul>	<ul style="list-style-type: none"> <li>• Select study teams to present conclusions for PS-113 through PS-122.</li> </ul>	

<b>Steps</b>	<b>Student Activity</b>	<b>Teacher Support</b>	<b>Comment/Evaluation</b>
<b>Homework</b>	<ul style="list-style-type: none"><li>• Review Unit 3.</li></ul>		