Unit 2: Reasoning, Proof, Parallel and Perpendicular

Content Area: **Mathematics**
Course(s): **Geometry Honors 8**
Time Period: **September**
Length: **4 weeks**
Status: **Published**

Transfer

Previous coursework: Used facts about complementary, supplementary, vertical, and adjacent angles to solve problems, informally defined congruency through transformations

By the end of this unit: Student should be comfortable with proofs about segments, parallel lines, angles pairs, and triangle congruency. The triangle sum theorem stems from the parallel line proofs and is a great application of those concepts. Constructions also play a part here- you can use constructions such as "copy a segment" and "copy an angle" as reasons in the proofs you write.

Instructional strategies:

- Although there is no explicit attention paid to conditional statements, thinking about proofs as "If statement 1, then statement 2, because reason 2" can help students feel the logical flow of the proof.
- Students generally get overwhelmed with the number of possible theorems, postulates, and corollaries in proofs- creating a "Reason Bank" has been helpful to give them a reference until they are familiar with the commonly used reasons.
- Another helpful option is to note which reasons generally occur together. For example, definition of vertical angles/ vertical angles are congruent/ definition of congruence occur together in many proofs.
- To begin the proofs, start with a lot of assistance and then as the students become more confident, challenge them little by little. For example, filling in reasons first, then statements, then giving each line of a proof out of order, followed by each statement out of order and no reasons.
- Also, encourage students to come up with a plan before they write even one line of the proof. Just have them informally write their ideas down to figure out the flow (maybe as a flow diagram) can really help organize their thoughts before the formal proof.
- Be sure to address different types of proofs- students generally gravitate toward flow or two-column formats, but maybe provide a paragraph proof for them to analyze so they are familiar with how to break it down into a format they are more comfortable with.
- (+) = denotes Honors only skill not on PARCC

Enduring Understandings

Transformations that do not have a change in scale produce congruent figures.

There are five ways to prove triangles congruent without proving all six parts congruent: SSS, ASA, SAS, AAS, and HL

Essential Questions

What are characteristics of a transformation that produces congruent figures?

What information is needed to prove two triangles congruent?

Critical Knowledge and Skills

Vocabulary

Learning Objectives

Write proofs involving solving algebraic equations.

Write basic proofs involving angles and segments.

Write advanced proofs involving segments and angles (+)

Prove and apply that vertical angles are congruent.

Prove and apply the angle relationships formed when two parallel lines are cut by a transversal.

Identify corresponding angles and sides based on congruence statements.

Write congruence statements for two congruent triangles.

Determine if two triangles are congruent based on their corresponding parts.

Explain and apply the criteria of SSS, SAS, ASA, AAS, and HL to prove triangles congruent.

Explain why AA and SSA don't prove triangle congruency.

Prove two triangles congruent (basic)

Prove two triangles congruent (advanced) (+)

Resources

Proofs using properties of Equality and Congruence

Proofs Involving Parallel Lines and Angle Pairs

Proving Triangles Congruent

Pearson Resources:

2-6, 3-2, 5-2, 3-5, 4-5, 5-1, Ch. 9 (use transformations to explain congruency)

Online Resources:

https://www.illustrativemathematics.org/HSG-CO.A

http://mr-stadel.blogspot.com/2012/10/transversals-tape-and-stickies.html

http://fivetriangles.blogspot.com/2014/04/155-three-angle-sum.html

http://fivetriangles.blogspot.com/2014/03/150-angle-sliver.html

http://map.mathshell.org/materials/lessons.php?taskid=212&subpage=concept

http://map.mathshell.org/materials/lessons.php?taskid=452&subpage=concept

Standards

RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP11. Use technology to enhance productivity.

9.1.8.A.2 Relate how career choices, education choices, skills, entrepreneurship, and economic conditions affect income.

9.1.8.C.5 Calculate the cost of borrowing various amounts of money using different types of credit (e.g., credit cards, installment loans, mortgages).

9.1.8.D.3 Differentiate among various investment options.

9.1.8.E.6 Compare the value of goods or services from different sellers when purchasing large quantities and small quantities.

9.2.8.B.7 Evaluate the impact of online activities and social media on employer decisions.

8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.

8.2.8.C.8 Develop a proposal for a chosen solution that include models (physical, graphical or mathematical) to communicate the solution to peers.

MA.8.F.A	Define, evaluate, and compare functions.
MA.8.F.A.3	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.
MA.8.F.B	Use functions to model relationships between quantities.
MA.8.F.B.4	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
MA.G-CO.A	Experiment with transformations in the plane
MA.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.
MA.G-CO.C	Prove geometric theorems

MA.G-CO.C.9	Prove theorems about lines and angles.
MA.G-CO.C.10	Prove theorems about triangles.
MA.G-CO.C.11	Prove theorems about parallelograms.
MA.G-CO.D	Make geometric constructions
MA.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.).
MA.G-CO.D.13	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.
MA.G-MG.A	Apply geometric concepts in modeling situations
MA.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).
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.7	Look for and make use of structure.
MA.G-GPE.B	Use coordinates to prove simple geometric theorems algebraically
MA.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).

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They 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. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.