

Lesson Plan (Math)

Grade/ Grade Band: 9 th grade Geometry		Topic/Title: 6-3 Conditions of Parallelograms	
Brief Class Description (contextual information including number of students, subject, level, IEP/ELL/GT or other special considerations): Mod 1B: This classroom environment is very relaxed. There are 30 students in the class, and there are many friends at tables which makes for productive noise. They feel comfortable joking around and having fun. There is one student who has had behavior problems with other teachers in the past, but he is said to have started new medication that will help this. Mod 3B: This period of students is less confident and needs more guidance than the other class. There are 25 students in this class. There is a group of boys who can get loud, but with nonverbal and verbal communication they will settle.			
Brief Lesson Description (Overview/Abstract): Students will use angle legs to explore the conditions of parallelograms and then play a game in order to extend their knowledge.			
Objective(s): I can prove that a certain quadrilateral is a parallelogram using coordinate geometry.			
Prior Student Knowledge: Students have learned the properties of parallelograms. In previous units, they have discussed conditional and biconditional statements.		Possible Preconceptions/Misconceptions: Students may be confused about the difference between a property and a condition.	
Common Core Standards: HSG-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.		Standards for Mathematical Practices: Attend to precision. Use appropriate tools strategically.	
Required materials: Angle Legs Conditions reference sheet		Safety considerations: N/A	Technology Integration/Needs: Projector
ENGAGE: (15 minutes)(75 minutes left) Task: Students will complete a drill that reviews properties of parallelograms by solving for unknown variables and sides. Students must apply the properties they learned in order to find the lengths of missing sides and measures of missing angles. Two people will be cold called to write their answers on the board and then two other people will explain how that person got the answer. Then they will be asked “What does it mean for a statement to be <i>Conditional</i> ?” This connects to previous knowledge. Students turn and talk and then a random spinner will be used to cold call a table to share what they talked about.			
Instruction: <i>Teacher instruction</i> Student Answers “Alright I will choose with the spinner two students to come up and do these on the board.” “[student], how did [student] get your answer for number 1?” Case 1: correct. “I set the opposite sides equal to each other, so $4x+20=x+26$. Then I solved and got $x=2$, and substituted that into the other side $6x+9$ and set that equal to $7y$ to figure out y . I got $y=3$.”			

Case 2: incorrect.

"I set the adjacent sides equal to each other, and got $x=5.5$ and $y=4.5$."

"[student] what did [other student] do to get the answer in number 2?"

Case 1: correct.

"Since the diagonals of a parallelogram bisect each other, $2y+2=2x$ and $x+9=2y$. Then this is a system of equations. So we eliminate y by multiplying the bottom equation by -2 and subtracting 2 from each side of the top equation, and then we get $x=11$. Then substitute that back in and get $y=10$."

Case 2: incorrect.

"Make $2y=2y+2$ and it's no solution."

"What does it mean for a statement to be conditional?"

"It's a condition."

"It's an if-then statement."

"Then the statement forward and backward is true." (Biconditional)

Transition: "I am handing out a pack of angle legs to each table. We are going to use these to prove some conditions!"

Instructional Strategies:

Spinner/Cold Call

Turn and Talk

EXPLORE/EXPLAIN Cycle(s)

EXPLORE:

(25 minutes)(50 minutes left)

Task: Each table group of students will be given a group of angle legs. As a guided exploration, I will model on the document camera each theorem for the conditions of parallelograms, excluding consecutive sides are supplementary. These theorems include one pair of opposite congruent and parallel sides; two pairs of opposite congruent sides; two pairs of opposite angles; and bisecting diagonals. For the bisecting diagonals theorem (Thm 6-3-5) I will use a large parallelogram manipulative at the front of the classroom for students to see. For each theorem, I will ask the students about the first (the "if") statement of the theorem, i.e. "If one pair of opposite sides are both parallel and congruent, does that mean the quadrilateral is a parallelogram?" Students will have about 1 minute to work with their teams and angle legs to see if they can provide an answer, and then I will use a spinner to cold call a table to share their answer. After the table has shared, I will model with angle legs (or large manipulative) on the document camera to clarify any confusion or misconception. While students are exploring the last theorem, I will hand out a paper with a list of conditions of parallelograms on it.

Instruction:

"Our first theorem is if we have one pair of opposite congruent and parallel sides. Does it have to be a parallelogram?"

"Next up is if we have opposite sides that are congruent. Does this have to be a parallelogram?"

"If we have opposite angles that are congruent?"

"What if we have diagonals that bisect each other? Does that quadrilateral have to be a parallelogram?"

Transition: "This is a reference sheet with conditions of parallelograms on it. You can use this to help you!"

Instructional Strategies:

Manipulatives

EXPLAIN (STUDENT CENTERED):**(20 minutes)(30 minutes left)**

Task: Students will use their reference sheet and the conditions they just explored to apply their knowledge to coordinate geometry by doing class and individual examples. The powerpoint is color coded and has pictures of graphs for visual learners. Students start by using the definition of a parallelogram to prove parallel sides, which they are familiar with. Then they move to using specific conditions to prove a quadrilateral is a parallelogram. Students must use slope and distance formula to prove.

Instruction:

"Let's do some examples! This says to use the definition of a parallelogram. What was the definition?"

Case 1: correct.

"A quadrilateral with two sets of parallel sides."

Case 2: incorrect.

"Two sides that are parallel."

"If the diagonals bisect."

"If the angles are congruent."

"Alright, two sets of parallel sides. What could we use to help us? We did a little bit of this yesterday."

"Slope formula!"

"Take a minute to see if the slopes of opposite sides are the same. If the slope is the same, then the sides are parallel."

Case 1: correct.

"One set of opposite sides have a slope of 5, and the other set has slope of $-3/4$."

Case 2: incorrect.

"Side AB is up 5 over 1, then CD is down 5 over 1 so they are opposites not equal. Then BC has slope $4/3$ and DA has slope $-3/4$. All the slopes are different so it is not a parallelogram."

Transition: "I am now handing out a worksheet for you to apply the conditions. You may use your reference sheet and notes to help you."

Instructional Strategies:

Color Coding

ELABORATE:**(25 minutes) (5 minutes remaining)**

Task: Students will spend 10 minutes working on their application worksheet, and then they will play The Unfair Game. The worksheet starts with solving for missing angles and sides, and determining if a quadrilateral is a parallelogram. Then it extends to coordinate geometry by giving students four points and instructing the use of certain theorems to determine if the quad is a parallelogram. Students must get out graph paper for this.

In today's game, students will be cold called with the spinner (the unfair part, a team could get called on more than once) and if their answer is correct they toss a tape ball into an empty trash can. The spot they throw from dictates the number of points the team gets. If the answer is incorrect, another team gets a try for the same question. The team that wins gets a prize (a high five).

Instruction:

"Alright I will give you 10 minutes to work on this handout, and then we will play a game with it."

"In this game, the Unfair Game, I will use the spinner to select a team that will answer the question. If that team answers correctly, they can come and throw the tape ball into the trash can from one of three spots. The farther away you are, the more points you get. If the team gets the answer wrong, another team will get

a chance to answer. Are there any questions?"

Transition: "Great job [table blank]! Come to me at the end of class to get your prize!"

Differentiation: To adapt for individuals, students may choose if they want to get up and toss the ball or have someone else do it for them. Students will also have time to collaborate group answers before the game starts. Trash can basketball is motivating for competitive students, and students may choose where they toss from (one of three spots).

Instructional Strategies:

Group work

Game

Cold Call

COGNITIVE CLOSURE

(5 minutes)

Task: A summary will be projected from the powerpoint. Students will individually write down three ways to prove a quadrilateral is a parallelogram on the coordinate plane in their notes. Then I will Cold Call three students to share their answers. After each student, I will ask the class to raise their hands if they used one of the same properties/conditions as an evaluation. While the students are raising their hands, I will note the students that are not and cold call on them for the next answer.

Instruction:

"Alright, table [blank] color [blank], what is one way to prove a quad is a parallelogram on the coordinate plane?"

Case 1: correct.

"Using slope to see if the opposite sides are parallel, using slope and distance to see if one set of sides is parallel and congruent, or using distance to see if opposite sides are the same."

Case 2: incorrect.

"If all the sides are equal then it is a parallelogram."

"Use a protractor to see if opposite angles are the same."

Instructional Strategies:

Cold Call

EVALUATE:

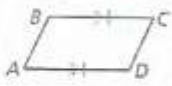

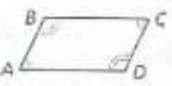
Diagnostic Assessment(s): Students complete a drill for me to gauge what they remember about properties of parallelograms from last class, and then the turn and talk about conditional statements will allow me to informally assess what the students remember about logic and conditions.

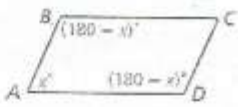

Formative Assessment(s): I can assess what the students have learned by cold calling during examples and asking for specific justifications and work shown; I can also formatively assess them by the unfair game (cold calling in game format).

Summative Assessment(s): Chapter 7 Test 4/20/18

Timing/Pacing Adjustments (Slinky Time): Include a plan for how to adjust instruction if tasks take longer/shorter than anticipated:

If there is more time than planned, students can take an exit ticket on what they have learned today. (+10 mins). If there is less time, then the last few questions of the game can be skipped and a simple cold call to go over the answers will suffice. (-5 mins)

Theorems Conditions for Parallelograms	
THEOREM	EXAMPLE
6-3-1 If one pair of opposite sides of a quadrilateral are parallel and congruent, then the quadrilateral is a parallelogram. (quad. with pair of opp. sides \parallel and $\cong \rightarrow \square$)	
6-3-2 If both pairs of opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram. (quad. with opp. sides $\cong \rightarrow \square$)	
6-3-3 If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram. (quad. with opp. $\angle \cong \rightarrow \square$)	

Theorems Conditions for Parallelograms	
THEOREM	EXAMPLE
6-3-4 If an angle of a quadrilateral is supplementary to both of its consecutive angles, then the quadrilateral is a parallelogram. (quad. with \angle supp. to cons. $\angle \rightarrow \square$)	
6-3-5 If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram. (quad. with diags. bisecting each other $\rightarrow \square$)	

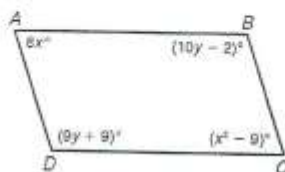
LESSON
6-3

Practice B

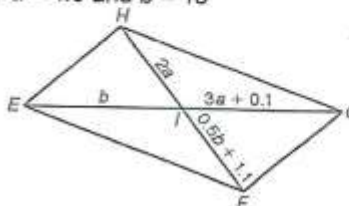
Conditions for Parallelograms

For Exercises 1 and 2, determine whether the figure is a parallelogram for the given values of the variables. Explain your answers.

1. $x = 9$ and $y = 11$

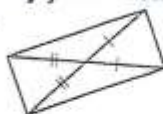


2. $a = 4.3$ and $b = 13$

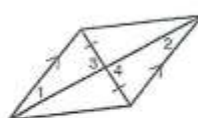


Determine whether each quadrilateral must be a parallelogram. Justify your answers.

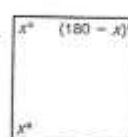
3.



4.



5.



Use the given method to determine whether the quadrilateral with the given vertices is a parallelogram.

6. Find the slopes of all four sides: $J(-4, -1)$, $K(-7, -4)$, $L(2, -10)$, $M(5, -7)$

7. Find the lengths of all four sides: $P(2, 2)$, $Q(1, -3)$, $R(-4, 2)$, $S(-3, 7)$

8. Find the slopes and lengths of one pair of opposite sides:

$T\left(\frac{3}{2}, -2\right)$, $U\left(\frac{3}{2}, 4\right)$, $V\left(-\frac{1}{2}, 0\right)$, $W\left(-\frac{1}{2}, -6\right)$
