Lesson Plan (Math)

Grade/ Grade Band: 9th grade Geometry	**Topic/Title:** 6-5: Conditions of Special 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 explore and match conditions of special parallelograms and then apply those properties and conditions in a competition.

Objective(s): I can use coordinate geometry in order to prove a given quadrilateral is a rectangle, rhombus, or square

Prior Student Knowledge:	**Possible Preconceptions/Misconceptions:**
Properties and Conditions of Parallelograms (general) was taught last week, Properties of Special Parallelograms (types and what each one has) was covered last class.	You must be given properties in order to classify a quadrilateral.
Common Core Standards: CCSS.MATH.CONTENT.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*. *CCSS.MATH.CONTENT.HSG.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). **NCTM:** Analyze properties and determine attributes of two- and three-dimensional objects. Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them. Establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others.	**Standards for Mathematical Practices:** **Math Practices:** Attend to Precision. Use appropriate tools strategically. Construct viable arguments and critique the reasoning of others.

Required materials: Drill Matching Handout Theorems handout Game worksheet Properties chart Phone-Geogebra	**Safety considerations:** na	**Technology Integration/Needs:** Projector Phone-Geogebra

ENGAGE:
(15 minutes)(75 minutes left)
Task: Students will work a drill that reviews how to prove a set of points yields a parallelogram. One student will be chosen to share an answer by random spinner, then the other ways to solve will be volunteered. Then jokes will be projected: "What do you call a crushed angle? A rectangle!" and "How did the square get to the park? It took a rhombus!" We will then go over the answers to the homework and copy down tonight's homework as well.

Show that the quadrilateral with vertices $E(-1, 5)$, $F(2, 4)$, $G(0, -3)$, and $H(-3, -2)$ is a parallelogram.
(hint: you can do any of the 3 ways we did last class)

slope of $\overline{EF}$ = slope of $\overline{GH}$ = $-\frac{1}{3}$

$EF = GH = \sqrt{10}$

Since one pair of opposite sides are $\parallel$ and $\cong$, $EFGH$ is a parallelogram by Theorem 6-3-1.

Instruction: *Teacher instruction* Student Answers
"Use the properties that we learned last class to figure out if this quadrilateral is a parallelogram."
"What is one way that we could prove this?"
"By using Theorem 6-3-1. If one pair of sides are parallel and congruent, then it is a parallelogram."
"Alright, up on the board now are the plotted points of the quad. What is the slope from E to F?"
"-1/3."
"Is it the same from G to H?"
"Yea!"
"And are the distances of EF and GH equal? If so what is it?"
"They are the same, it is the square root of ten."
Other ways:
Theorem 6-3-2: Prove both pairs of sides are congruent. EF and GH are$\sqrt{10}$, FG and HE are $\sqrt{53}$.
Theorem 6-2-1 (Definition): Prove the slopes of pairs of sides are parallel. EF and GH are -1/3, FG and HE are 7/2.

Transition: "Remind me, what is a conditional statement?"

Instructional Strategies:
Random generator

EXPLORE/EXPLAIN Cycle(s)
EXPLORE:
(15 minutes)(60 minutes left)
Task: Students will be given a handout asking them to match each shape to the most correct, most specific set of properties/conditions. They will be instructed to use https://www.geogebra.org/m/fyFP4EwG#material/ZnYkbW3N on their phones to help them. Not all properties and conditions are shown on the handout.

Instruction:
"Being handed to you now is a handout that has 4 sets of properties and conditions along with 4 types of parallelograms. There is also a QR code on the board! This goes to a geogebra site, you can also access it from a lesson tile on bcpsone. Using the website to help you, match each quadrilateral to a set of conditions. You may collaborate with your groups to figure this out. Write your match in the set section, there is plenty of room for you to write it. Are there any questions?"

Transition: "Up on the board now is the Geogebra website you used to match the conditions and quads. What types of quadrilaterals are these?"

Instructional Strategies:
Technology
Matching

EXPLAIN (STUDENT CENTERED):
(25 minutes)(35 minutes left)
Task: Students will get a conditions theorems handout as reference for the conditions of special parallelograms (rectangles and rhombuses). Students will work in their groups on problems relating special parallelograms to coordinate geometry. First they will turn and talk about the first example and the ways they could prove the type of quadrilateral, and then they will use graph paper to plot the points and classify using slope and/or distance formula.

Instruction:
"We will quickly go through the different conditions for special parallelograms. If one angle in a parallelogram is a right angle, do all the rest have to be as well?" "Yes."
"Then by the properties we learned last class, the quad must be a rectangle."
"If the diagonals are congruent, then we have congruent triangles here *writes on board with marker* *and since this is a parallelogram, these two angles must be supplementary but by CPCTC they are congruent. So we have right angles and then that means this is a rectangle! Cool, right?!"*
"If we have a parallelogram with congruent consecutive sides, then the opposite sides must be congruent as well so all the sides are equal length and this is a rhombus."
"If the diagonals of a parallelogram are perpendicular, so we have congruent angles here which by SAS makes congruent triangles here *Gestures* *and then by CPCTC we have consecutive sides that are congruent which means this is a rhombus!"*
"If a parallelogram has diagonals that are angle bisectors, then we have congruent angles here, which make congruent triangles here, which means we have congruent consecutive sides! Rhombus!"
"Let's apply our new knowledge! You need graph paper out. Please plot the points on the board and then talk with your table about how we could figure out what type of parallelogram this is."
Ways: Find the distance between two consecutive sides or prove the slopes of the diagonals are perpendicular.
"Work with your tables on these next two coordinate problems."

Transition: "Let's summarize what we've learned for the past couple weeks."

Instructional Strategies:
Group work

ELABORATE:
(27 minutes) (8 minutes remaining)
Task: Students will summarize their learning by shouting out in a check for understanding. In table groups students will apply the properties and conditions of special parallelograms and connect them to algebra by competing in a Velcro ball game. A problem will be projected and students will work in groups to complete. Then a random student (chosen by spinner) will answer and if correct, toss a ball to a points board and earn his/her team points. The team with the most points at the end of the game gets a special prize (A fist bump from me!)

Instruction:
"Alright, now we are going to get ready to play a game. For 15 minutes, use your notes to complete the front and back of this worksheet. We should be working independently. Then after those minutes, we will divide into teams and play the unfair game again! Only this time instead of a trash can, we get to use a Velcro points board! With that to look forward to, please work quietly for the next 15 minutes."
"Now, as a refresher, I will randomly select a team to shout an answer. If you are incorrect, someone else gets picked. If you are correct, you can come up to this tape line here and throw the ball at the points board. Throw it until you make it on the board. That will be how many points your team gets. Any questions?"
"Is there a prize?"
"Yea! There is a prize at the end for the team with the most points."

Transition: "Awesome job team [insert]! Come to me at the end of class to get your prizes!"

Differentiation: If a shy student feels uncomfortable throwing the ball, they can ask another student to throw for them. That student still needs to answer the question but if they do not feel comfortable they do not have to get up and throw.

Instructional Strategies:
Game
Check for Understanding

COGNITIVE CLOSURE
(8 minutes)

Task: Students will hold up a hand, 1 finger if they are completely confused with properties and conditions of a parallelogram, 5 fingers if they understand completely. Then students will get out their chart of all geometric figure properties and we will fill in the figures we have learned about this week.

Instruction:

"Alright, now that our game of applying properties and conditions is over, hold up a number for me 1

through 5. 1 is “Miss Trumble, I need to sign up for MAV time help because I don’t have any clue about this.” And 5 is “I completely fully understand.”

“Cool! Are there any specific questions anyone has about the conditions for today?”

“Get out the properties chart I gave you last class, we are going to fill in our rectangle, rhombus, and square sections.”

Differentiation: If a student does not wish to show the entire class how they feel, they can just put the number to their chest and I will still be able to see and evaluate.

Instructional Strategies:

Number self-assessment

EVALUATE:

Diagnostic Assessment(s): Observation of exploration activity; drill (review of properties of special parallelograms)

Formative Assessment(s): Checks for understanding; questions/participation; game worksheet completion.

Summative Assessment(s): Chapter 6 test, Quiz.

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

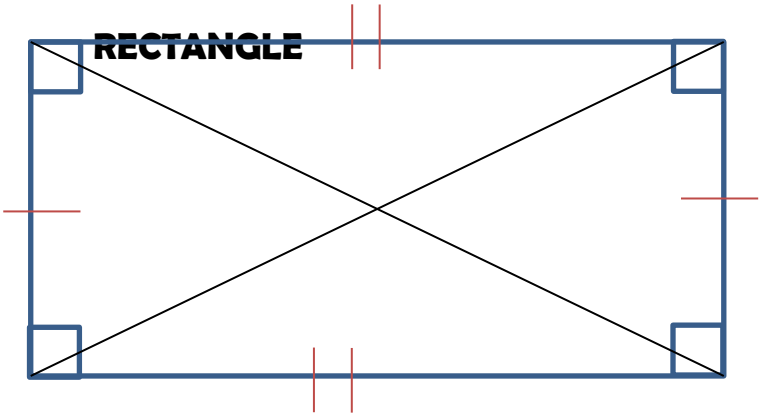
If there is more time, there is more practice with classifying quadrilaterals and proving properties and conditions that students can do in groups (+5-7)

If there is less time, the game can be cut short with an answer key projected on the board and posted to a lesson tile for students to refer to. (-5)

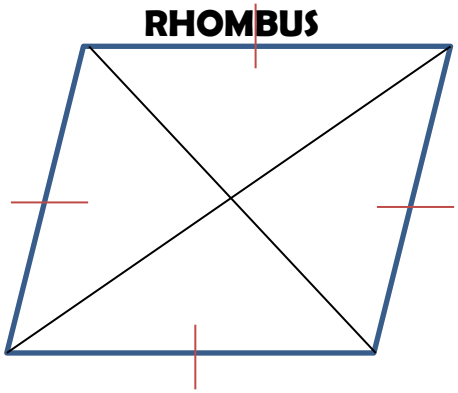
Match each shape to the correct set of properties/conditions:

• 2 sets of parallel sides • One right angle given • Consecutive sides are congruent
• 2 sets of parallel sides • Diagonals are congruent
• 2 sets of parallel sides • 2 sets of congruent angles
• 2 sets of parallel sides • Consecutive sides are congruent • Diagonals are angle bisectors • Diagonals are perpendicular

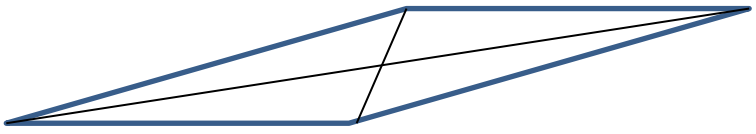
RECTANGLE



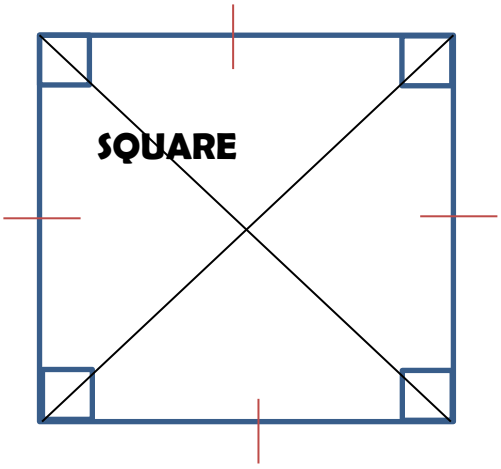
RHOMBUS



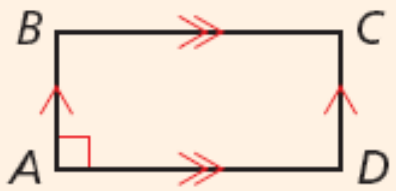
PARALLELOGRAM



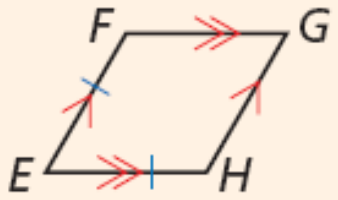
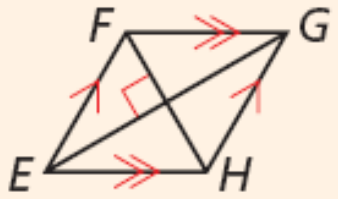
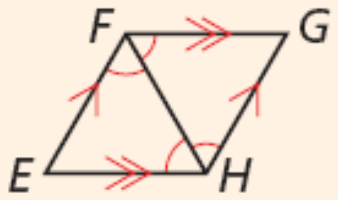
SQUARE



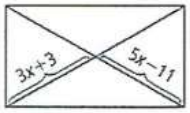
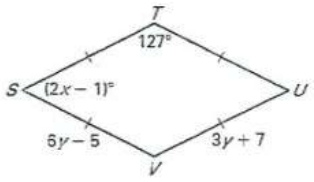
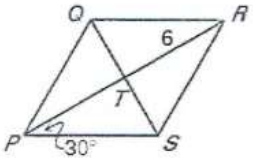
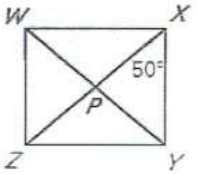
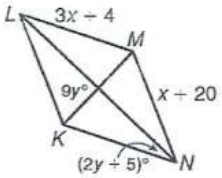
Theorems Conditions for Rectangles

THEOREM		EXAMPLE
6-5-1	If one angle of a parallelogram is a right angle, then the parallelogram is a rectangle. (▱ with one rt. ∠ → rect.)	
6-5-2	If the diagonals of a parallelogram are congruent, then the parallelogram is a rectangle. (▱ with diags. ≅ → rect.)	 $\overline{AC} \cong \overline{BD}$

Theorems Conditions for Rhombuses

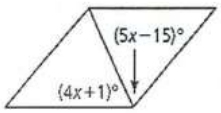
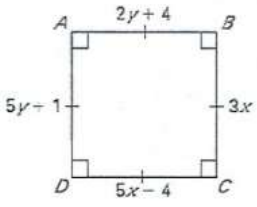
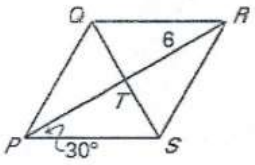
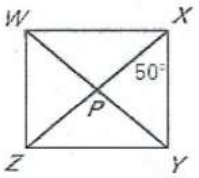
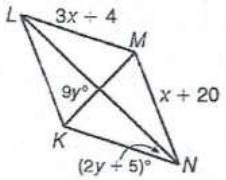
	THEOREM	EXAMPLE
6-5-3	If one pair of consecutive sides of a parallelogram are congruent, then the parallelogram is a rhombus. (▱ with one pair cons. sides ≅ → rhombus)	
6-5-4	If the diagonals of a parallelogram are perpendicular, then the parallelogram is a rhombus. (▱ with diags. ⊥ → rhombus)	
6-5-5	If one diagonal of a parallelogram bisects a pair of opposite angles, then the parallelogram is a rhombus. (▱ with diag. bisecting opp. ∡s → rhombus)	

G2c Properties of Special Parallelograms

What value of x makes each figure the given special parallelogram? **Rectangle**  	Classify the quadrilateral. Explain your reasoning. Then find the values of x and y.  	For any rhombus $ABCD$, decide whether the statement is always or sometimes true. Draw a diagram and explain your reasoning. $\overline{CA} \cong \overline{DB}$
The diagonals of rhombus $PQRS$ intersect at T. Given that $m\angle RPS = 30°$ and RT=6, find $m\angle QTP$.  	The diagonals of rectangle $WXYZ$ intersect at P. Given that $m\angle YXZ = 50°$ and XZ=12, find the measure of PY.  	$KLMN$ is a rhombus. Find LK. 

Answers

G2c Properties of Special Parallelograms

What value of x makes each figure the given special parallelogram? **Rhombus**  	Classify the quadrilateral. Explain your reasoning. Then find the values of x and y.  	For any rhombus $ABCD$, decide whether the statement is always or sometimes true. Draw a diagram and explain your reasoning. $\angle ABC \cong \angle CDA$
The diagonals of rhombus $PQRS$ intersect at T. Given that $m\angle RPS = 30°$ and RT=6, find $m\angle PQR$.  	The diagonals of rectangle $WXYZ$ intersect at P. Given that $m\angle YXZ = 50°$ and XZ=12, find the measure of $m\angle YZX$.  	$KLMN$ is a rhombus. Find $m\angle MNL$. 

Answers

Property	Parallelogram	Rectangle	Rhombus	Square	Trapezoid	Kite
Opposite Sides are Parallel						
Opposite sides are congruent						
Opposite angles are congruent						
Diagonals are congruent						
Diagonals are perpendicular						
Diagonals bisect each other						
All angles are right angles						
All sides are congruent						