Lesson 19

Objective: Draw kites and squares to clarify their attributes, and define kites and squares based on those attributes.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (4 minutes)
- Concept Development (34 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

Fluency Practice (12 minutes)

- Sprint: Multiply by Multiples of 10 and 100 5.NBT.2 (8 minutes)
- Divide by Multiples of 10 and 100 5.NBT.2 (4 minutes)

Sprint: Multiply by Multiples of 10 and 100 (8 minutes)

Materials: (S) Multiply by Multiples of 10 and 100 Sprint

Note: This fluency activity reviews Module 2.

Divide by Multiples of 10 and 100 (4 minutes)

Materials: (S) Personal white board

Note: This fluency activity reviews Module 2.

T: (Write $240 ÷ 10 = \underline{\hspace{1cm}}$.) Say the division sentence.

T: (Write $240 ÷ 10 = 24$. To the right, write $24 ÷ 2 = \underline{\hspace{1cm}}$.) Say the division sentence.
S: $24 ÷ 2 = 12$.

T: (Write $24 ÷ 2 = 12$. Below it, write $240 ÷ 20 = \underline{\hspace{1cm}}$.) Say $240 ÷ 20$ as a division sentence, but divide first by 10 and then by 2 rather than by 20.
S: $240 ÷ 10 ÷ 2 = 12$.
T: (Write $240 ÷ 20 = 12$.)

Continue the process for the following possible sequence: $690 ÷ 30, 8,600 ÷ 20, 4,800 ÷ 400$, and $9,600 ÷ 300$. 

Application Problem (4 minutes)

The teacher asked her class to draw parallelograms that are rectangles. Kylie drew Figure 1, and Zach drew Figure 2. Zach agrees that Kylie has drawn a parallelogram but says that it is not a rectangle. Is he correct? Use properties to justify your answer.

Note: Today’s Application Problem gives students another opportunity to verbalize the hierarchical nature of the relationships between types of quadrilaterals.

Concept Development (34 minutes)

Materials: (T) Quadrilateral hierarchy with kite: color (Template 2) (S) Ruler, set square or square template, protractor, scissors, quadrilateral hierarchy with kite (Template 1)

Problem 1

a. Draw a square, and articulate the definition.

b. Measure and label its angles to explore their relationships.

c. Measure to explore diagonals of squares.

T: What shapes have we drawn so far?

S: Quadrilaterals. → Rhombuses and rectangles. → Trapezoids and parallelograms, but in a rhombus all sides are the same length.

T: Can a rectangle ever be a rhombus? Can a rhombus ever be a rectangle? Turn and talk.

S: Well, a rectangle and a rhombus are both parallelograms. A rectangle must have right angles, but a rhombus can have angles that are not right angles. → Rhombuses must have four equal sides, but rectangles might not. → A square is a rhombus and a rectangle at the same time.

T: Let’s see if we can answer this question by drawing.

T: Draw a segment 3 inches long on your blank paper, and label the endpoints A and B.

S: (Draw a segment.)

T: (Demonstrate.) Now, using your set square, draw three-inch segments from both point A and point B at a 90° angle to \(\overline{AB}\). Draw both line segments toward the bottom of your paper.

S: (Draw additional line segments.)

T: Label the endpoints as C and D. Are \(\overline{AC}\) and \(\overline{BD}\) parallel? How do you know?

S: I checked with my set square. They are parallel. → They must be parallel because we drew them both as right angles to the same segment.

T: Use your straightedge to connect points C and D.
Lesson 19: Draw kites and squares to clarify their attributes, and define kites and squares based on those attributes.

NOTES ON MULTIPLE MEANS OF REPRESENTATION:

English language learners and others may feel overwhelmed distinguishing terms in this lesson. To support understanding, point to a picture or make gestures to clarify the meaning of parallel, rhombus, attribute, etc., each time they are mentioned. Building additional checks for understanding into instruction may also prove helpful, as might recording student observations of shape attributes and definitions in a list, table, or graphic organizer.

T: Measure segment $CD$. What is its length?
S: $\overline{CD}$ is also 3 inches long.
T: What have we drawn? How do you know?
S: A square. It has four right angles and four equal sides.
T: Based on the properties of parallel sides, tell your partner another name for this shape, and justify your choice.
S: It is a trapezoid. It has a pair of parallel sides. I can call this a parallelogram because there are two sets of parallel sides.
T: Use your protractor to measure angles $C$ and $D$. What are their measures?
S: $90^\circ$. All of the angles are $90^\circ$.
T: Since this is a parallelogram with four right angles and two sets of opposite equal sides, what can we call it?
S: A rectangle.
T: Since this is a parallelogram with four equal sides, what can we call it?
S: A rhombus.
T: Let’s return to our question, can a rhombus ever be a rectangle? Can a rectangle ever be a rhombus? Why or why not?
S: Yes. A square is a rhombus and a rectangle at the same time. A rectangle can be a rhombus if it is a square. A rhombus can be a rectangle if it is a square.
T: Using what you just drew, list the attributes of a square with your partner.
S: A square has four sides that are equal and four right angles. A square has opposite sides that are parallel, four right angles, and sides that are all equal in length. A square is a rectangle with four sides that are equal length. A square is a rhombus with four right angles.
T: Draw the diagonals of the square. Before we measure them, predict whether the diagonals will bisect each other, and justify your predictions using properties. Turn and talk.
S: The parallelograms we drew had bisecting diagonals, and this is definitely a parallelogram. I think the diagonals will bisect. I think they will bisect each other because a square is a rectangle, and all the rectangles’ diagonals we measured bisected each other. We drew rhombuses yesterday, and all those diagonals bisected each other. A square is a rhombus, so that should be true in a square, too.
T: Measure the lengths of the diagonals. Then, to test your prediction, measure the distance from each corner to the point where they intersect.
S: (Draw and measure.)
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Problem 2

a. Draw a kite, and articulate the definition.
b. Measure and label its sides and angles to explore their relationships.
c. Measure to explore diagonals of kites.

T: We have one more quadrilateral to explore. Let’s see if you can guess the figure if I give you some real-world clues. It works best outside on windy days, and it is flown with a string. (Give clues until the figure is named.)

S: A kite.
T: Sketch a kite.
S: (Sketch.)
T: Compare your kite to your neighbor’s. How are they alike? How are they different? Turn and talk.
S: Mine is narrow, and my partner’s is wider. → Mine is taller, and my partner’s is shorter. → They all have four sides.

T: Let’s draw a kite using our tools. Draw an angle of any measure with two sides that are the same length but at least two inches long. Mark the vertex as I and the endpoints of the segments as K and T.
S: (Draw a kite.)
T: Use your scissors to cut along the rays of your angle.
S: (Cut along the rays.)
T: Fold your angle in half matching points K and T. (Refer to the image.) Open it, and mark a point on the fold, and label it E.
S: (Fold and label.)
T: Use your ruler to connect your point to the ends of the other segments. Then, cut out your kite.
S: (Cut out the kite.)
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T: Measure the two sides that you just drew. What do you notice about the sides? How are they different from parallelograms?

S: There are two sets of sides that are equal to each other, but they are next to each other, not across from each other. → Opposite sides are not equal on mine, but adjacent sides are. → None of these sides are parallel to each other.

T: Use your protractor to measure the angles of your kite, and record the measurements on your figure.

S: (Measure and record the angles of the kite.)

T: What do you notice? Turn and talk. (Allow students time to share with a partner.)

S: There are always at least two angles of equal measure. They are across from each other where the unequal sides meet. → My kite is also a square. It has two pairs of equal angles.

T: Now, draw the diagonals of the kite. Measure the length of the diagonals, the segments of the diagonals, and the angles where the diagonals intersect.

S: (Draw and measure the diagonals, segments, and angles.)

T: What can you say about the diagonals of a kite? Turn and talk.

S: My diagonals cross outside my kite, but they are still perpendicular. → The diagonals are not the same length. → The diagonals meet at 90° angles; they are perpendicular. → One diagonal bisects the other, but they are not both bisected.

T: What are the attributes of a kite? Tell your partner.

S: A kite is a quadrilateral with equal adjacent sides. → It is a quadrilateral with two pairs of adjacent sides that have equal lengths.

NOTES ON KITES:
If no student produces a concave kite (an arrowhead) through the process of drawing in the lesson, draw one for students to consider. It is important to note that although the diagonals do not intersect within the kite, the same relationships hold true. The lines containing the diagonals intersect at a right angle, and only one bisects the other. Students who produce such a kite may need help drawing the diagonals.
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The Student Debrief is intended to invite reflection and active processing of the total lesson experience. Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. Any combination of the questions below may be used to lead the discussion.

- (Allow students to share the myriad of squares and kites that are produced in Problem 1 of the Problem Set.) Compare and contrast these quadrilaterals.
- (Use the figures produced in Problem 1 to articulate the formal definitions of both squares and kites. Continue to post the definitions.)

A square:
- Is a rhombus with four right angles.
- Is a rectangle with four equal sides.

A kite:
- Is a quadrilateral in which two consecutive sides have equal length.
- Has two remaining sides of equal length.
(Consolidate the lists of attributes students generated for squares and kites in Problem 3.)
What attributes do all squares share? What attributes do all kites share? When is a quadrilateral a kite but not a square or rhombus?
When can a quadrilateral also be called a square?
Respond to the following statements with true or false. Explain your reasoning.
- All squares are quadrilaterals. (True. All squares have four sides.)
- All quadrilaterals are squares. (False. Not all quadrilaterals have equal side lengths.)
- All rhombuses are squares. (False. All rhombuses must have four equal sides, but the angles do not have to be 90°.)
- All squares are rhombuses. (True. The defining attribute of a rhombus is that its four sides must be equal in length. Squares also have four sides of equal length.)
- All rectangles are squares. (False. Rectangles do not have to have four sides of equal length.)
- All squares are rectangles. (True. The defining attribute of a rectangle is that it must have four right angles. All squares have four right angles.)
- All squares are parallelograms. (True. All parallelograms have two sets of parallel sides. All squares have two sets of parallel sides.)
- All parallelograms are squares. (False. Squares must have four right angles and four equal sides. If a shape has four right angles, it will also have two sets of parallel sides. Parallelograms only need to have two sets of parallel sides.)
- All kites are quadrilaterals. (True. All kites are closed, four-sided figures.)
- All quadrilaterals are kites. (False. There are many four-sided shapes that do not have two sets of equal adjacent sides.)
- All kites are squares. (False. Squares must have 4 equal sides, but kites only need to have 2 pairs of equal sides.)
- All squares are kites. (True. Squares have 2 pairs of equal adjacent sides.)

(Finish the construction of the hierarchy diagram. (See Templates 1 and 2 at the end of this lesson.) Students might draw or glue examples of squares and kites or list attributes within the diagram. Encourage students to explain their placement of the figures in the hierarchy.)

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students’ understanding of the concepts that were presented in today’s lesson and planning more effectively for future lessons. The questions may be read aloud to the students.
### Multiply by Multiples of 10 and 100

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### Multiply by Multiples of 10 and 100

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**Number Correct:** ________

**Improvement:** ________
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1. Draw the figures in each box with the attributes listed. If your figure has more than one name, write it in the box.

   a. Rhombus with 2 right angles
   b. Kite with all sides equal
   c. Kite with 4 right angles
   d. Kite with 2 pairs of adjacent sides equal (The pairs are not equal to each other.)

2. Use the figures you drew to complete the tasks below.

   a. Measure the angles of the figures with your protractor, and record the measurements on the figures.

   b. Use a marker or crayon to circle pairs of angles that are equal in measure, inside each figure. Use a different color for each pair.
3. a. List the properties shared by all of the squares that you worked with today.

b. List the properties shared by all of the kites that you worked with today.

c. When can a rhombus also be called a square?

d. When can a kite also be called a square?

e. When can a trapezoid also be called a kite?
1. List the property that must be present to call a rectangle a square.

2. Excluding rhombuses and squares, explain the difference between parallelograms and kites.
1. a. Draw a kite that is not a parallelogram on the grid paper.

   b. List all the properties of a kite.

   c. When can a parallelogram also be a kite?

2. If rectangles must have right angles, explain how a rhombus could also be called a rectangle.

3. Draw a rhombus that is also a rectangle on the grid paper.
4. Kirkland says that figure $EFGH$ below is a quadrilateral because it has four points in the same plane and four segments with no three endpoints collinear. Explain his error.
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quadrilateral hierarchy with kite: color