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Objective

To classify two-dimensional figures based on characteristics of their sides and angles

1 Introduction

Discuss the different classifications for triangles: acute, obtuse, right, equilateral, isosceles, and scalene. Draw, or have students draw, examples of each type on the board. Then classify each triangle based on both its angles and its side lengths. Look at the chart showing the classifications of quadrilaterals. Discuss how some quadrilaterals fall into more than one category.

LESSON **35** Classifying Two-Dimensional Figures CC.2.3.5.A.2

1 Introduction

Polygons, or two-dimensional figures with line segments for sides, can be classified into groups based on their characteristics, such as angles, parallel sides, and congruent sides.

Congruent means "equal in size."

This table shows you how to classify a triangle.

TRIANGLES					
By Angles			By Sides		
Acute	Obtuse	Right	Equilateral	Isosceles	Scalene
3 angles that are less than 90° each	1 angle that is greater than 90°	1 angle that is equal to 90°	3 sides of equal length	at least 2 sides of equal length	no sides of equal length

Identifying both the angle and side attributes can help you classify triangles.

The triangle has 2 equal sides and an angle greater than 90° . Having 2 equal sides means the triangle is an isosceles triangle. The angle greater than 90° means that the triangle is obtuse.

Sides marked with tick marks are congruent.

This is both an isosceles and an obtuse triangle.

This chart shows you how to classify quadrilaterals.

All of the figures in the chart are quadrilaterals. A square is a type of rectangle and rhombus. The square, rectangle, and rhombus are parallelograms.

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Think About It

Students should recognize that a circle is not a polygon because it does not have line segments for sides. It is a plane figure because it is two-dimensional.

Think About It

A polygon is a closed figure with sides that are line segments. Is a circle considered a polygon and a plane figure? Explain.

2 Focused Instruction

Classify triangles based on their angles and their side lengths.

► Jeff's backyard has a triangular shape and is bordered by the house and two sides of fencing.

He knows that the angle created by the two fences measures 90° . He also knows that the shortest side is about 12 feet. The longest side is about 25 feet. The remaining side is 10 feet greater than the shortest side. Classify the yard shape using both the angles and side lengths.

What is the measure of the known angle of the backyard? 90°

What is the name for an angle of this measure?
right

What is the measure of the longest side? about 25 feet

What is the measure of the shortest side? about 12 feet

How can you find the measure of the remaining side?
Add 10 to the shortest length.

What is the measure of the remaining side? about 22 feet

Are any of the sides equal? no

A right angle makes a square corner.

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PA Core Standard

CC.2.3.5.A.2 Classify two-dimensional figures into categories based on an understanding of their properties.

Eligible Content

M05.C-G.2.1.1 Classify two-dimensional figures in a hierarchy based on properties.

2 Focused Instruction Lesson 35

What type of triangle has sides with this relationship?
scalene

What are the angle and side classifications for this triangle?
right and scalene

What type of triangle is Jeff's backyard? right scalene

Classify quadrilaterals based on parallel and congruent sides and the number of right angles.

► A scouting group has a troop flag shaped like the one below.



The top of the flag is parallel to the bottom of the flag. The middle line of the flag is parallel to the bottom of the flag. Classify the green section of the flag.

Are the top and bottom of the flag parallel? yes

Are the bottom of the flag and the middle line parallel? yes

Are the middle line and top of the flag parallel? yes

How do you know?

Parallel lines never meet. They are always the same distance apart.

The middle line is parallel to the bottom of the flag and the bottom is parallel to the top, so the middle line must also be parallel to the top.

Are the right and left sides of each section parallel? no

What type of figure has these types of sides? trapezoid

How many sides does the green section of the flag have? 4

What larger group does this figure fit within?
quadrilateral

2 Focused Instruction Lesson 35

Is the figure in all of the same classifications as a rectangle? Why or why not?
No, it does not have 2 pairs of parallel sides or 2 pairs of sides with equal lengths.

Use what you know about two-dimensional figures to answer these questions.

1 Which of the figures is not a parallelogram?



C

2 Which of the figures is an acute isosceles triangle?



B

2 Focused Instruction

First, students will classify a triangle based on its side lengths and angle measures. They will recognize that the triangle has a 90° angle, therefore it is a right triangle. The side lengths are 12, 22, and 25 feet, so it is a scalene triangle because none of the sides are the same length.

Next, students will look at the polygons that make up a flag. They must recognize that two sides are parallel and then use that information to classify the polygons as trapezoids, as well as quadrilaterals.

Conclude the Focused Instruction section by having students answer two questions about classifying figures.

Vocabulary

- acute triangle:** a triangle with three acute angles
- equilateral triangle:** a triangle with three sides of the same length and three 60° angles
- isosceles triangle:** a triangle with at least two equal sides
- obtuse triangle:** a triangle with one obtuse angle
- right triangle:** a triangle with one right angle
- scalene triangle:** a triangle with no equal sides

Connections to Standards for Mathematical Practice

- Make sense of problems and persevere in solving them.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Attend to precision.

3 Guided Practice

Students should complete the Guided Practice section on their own. Offer assistance as needed, pointing out the reminder and hint boxes along the right side of the page.

4 Independent Practice Answer Rationales

1 For choice A, the student may think that a right angle measures 60° , and that since two of the sides are the same length, it is isosceles. Since there are three sides the same length, equilateral is a better classification. Choice B is incorrect. The student misunderstood scalene to mean that the side lengths are all the same and incorrectly named the triangle as obtuse. For choice C, the student correctly identified the triangle as acute based on its angle size, but the student incorrectly identified the triangle as isosceles, because the triangle has three congruent sides, not two. Choice D is correct. The triangle is an equilateral triangle because all of the sides are equal. The triangle is also acute. Since all of the sides are congruent, all of the angles are congruent as well. All three angles are 60° .

2 **PART A** The total angle sum of a four-sided figure is 360° . If there are two right angles, then the two known angles measure $90 + 90 = 180^\circ$. To find the remaining measure for the figure, subtract 180° from the total angle sum. $360 - 180 = 180^\circ$. The two remaining angles are also congruent, so they can be found by dividing the remaining measure (180°) by 2: $180 \div 2 = 90^\circ$.

PART B The two remaining angles are right angles. The figure has four right angles. The figure also has four congruent sides. A figure with four right angles and four congruent sides is a square. A square is also a rhombus, a rectangle, a parallelogram, and a quadrilateral.

3 The football field can be classified as a quadrilateral because it has four sides. It is also a parallelogram because it has two pairs of parallel sides, and each pair of sides is congruent. The narrowest classification is a rectangle, therefore the figure is a rectangle.

3 Guided Practice Lesson 35

Solve the following problems.

1 Mr. Delgado uses the ladder shown to hang pictures. What kind of triangle is formed by the sides of the ladder and the ground?

First, look at the triangle's angles. Then look at its sides.

Answer acute, isosceles

2 Look at the figure below.

Use the angles to determine what type of figure it is.

Answer a rhombus

3 Isabella classified a rectangle as a parallelogram. Is she correct? Explain.

A rectangle is always a parallelogram, because a parallelogram has 2 pairs of parallel sides. Each pair of sides in a congruent rectangle are parallel, so it is a parallelogram.

How many right angles are in the figure?

What makes a figure a parallelogram? Is this true for a rectangle?

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4 Independent Practice Lesson 35

Solve the following problems.

1 A triangle has sides that are 16 feet, 16 feet, and 16 feet in length. One angle is 60° . Which choice best describes the triangle? **DOK 2 M05.C-G.2.1.1**

A right and isosceles
 B obtuse and scalene
 C acute and isosceles
 D acute and equilateral

2 A four-sided figure with two right angles has two additional angles that are congruent to each other. The figure also has sides that are congruent. **DOK 2 M05.C-G.2.1.1**

Part A What is the measure of the two remaining angles? Explain how you found your answer.

The figure has 2 right angles. The angle sum of a 4-sided figure is 360° . If the figure has 2 right angles, then the known angles measure a total of 180° . The remaining congruent angles have a sum of 180° . These angles measure 90° each.

Part B What are all of the classifications for this figure?

Answer square, rhombus, rectangle, parallelogram, and quadrilateral

3 A typical football field is shown here. **DOK 2 M05.C-G.2.1.1**

What is the most specific description of the shape of the football field?

Answer rectangle

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4 Independent Practice Lesson 35

4 A typical baseball field is shown below. The right angle symbols mark the locations of first base, second base, third base, and home plate. **DOK 3**
M05.C-G.2.1.1

Part A During practice, the coach has the players throw the ball from first to second base, from second to third base, and from third base back to first base. What kind of triangle does the path of the ball make? Explain your answer.

The ball makes a path in the shape of a right isosceles triangle because the angle at second base is 90 degrees and the distances from first to second base and second to third base are congruent.

Part B The first and third baselines extend into the outfield and end at the foul poles. The left field foul pole is 318 feet from home plate. The right field foul pole is 314 feet from home plate. Is the triangle formed by the first and third base lines and the dashed line between them the same as the triangle formed in Part A? Explain your answer.

The angle is the same, so the triangle is a right triangle. However, because the two sides of the triangle are not congruent, the triangle is a scalene triangle.

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4 Independent Practice Lesson 35

5 Sen-Yung is flying her kite at the park. The outside edges of the green section of the kite are congruent. The outside edges of the gray section of the kite are congruent. There are no pairs of sides that are parallel. **DOK 1**
M05.C-G.2.1.1

Which classification group does the kite fit within?

Answer quadrilateral

6 Mark the correct space in the table to show the classifications for each polygon. You may mark more than one space for some polygon.

	Square	Rectangle	Rhombus	Parallelogram	Other Quadrilateral
	✓	✓	✓	✓	
					✓
		✓		✓	
			✓	✓	
				✓	

DOK 2
M05.C-G.2.1.1

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4 PART A The triangle formed by the lines is right and isosceles because the angle at second base is a right angle and the distances from first base to second base and second base to third base are both 90 ft, so the triangle has a right angle and two congruent sides.

PART B The triangle has a right angle formed at home plate, so the triangle is a right triangle. The distances from home plate to each of the foul poles are not congruent, so the triangle is not an isosceles triangle. It is a scalene triangle.

5 The kite has two pairs of congruent sides. The kite has two pairs of congruent angles. None of the sides are parallel. The kite is a quadrilateral but not a parallelogram because it does not have two pairs of parallel sides.

6 The first figure is a square. A square is also a rectangle and a parallelogram because it has two pairs of parallel sides and two pairs of congruent sides. It is also a rhombus because it has four sides that are the same length. The second figure is a trapezoid, which cannot be classified under another category except for other quadrilateral. The third figure is a rectangle. A rectangle is also a parallelogram because it has two pairs of parallel sides and two pairs of congruent sides. The fourth figure is a rhombus because it has four congruent sides with parallel pairs. The rhombus is also a parallelogram because it has two pairs of parallel and congruent sides. The fifth figure is a parallelogram because it has two pairs of parallel sides and two pairs of congruent sides.

Extension Activity

For homework, have students locate examples of a right triangle, an acute triangle, and an obtuse triangle outside of school. For each example, students should draw the triangle and classify it according to its side lengths and angle measures.