Learning Goal:
Students will be able to classify plane figures according to their properties.

<table>
<thead>
<tr>
<th>GOALS</th>
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</thead>
<tbody>
<tr>
<td>4      Students will be able to classify a polygon into all the subcategories to which it belongs and begin to understand the concepts of perimeter and circumference.</td>
</tr>
<tr>
<td>3      Students will be able identify all the subcategories to which a specific figure belongs.</td>
</tr>
<tr>
<td>2      Students will be able to name plane figures according to their shape or the number of sides.</td>
</tr>
<tr>
<td>1      Students will be able to recognize figures as polygons or non-polygons.</td>
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</tr>
<tr>
<td>1</td>
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<tr>
<td>2</td>
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<tr>
<td>1</td>
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</tbody>
</table>
Identifying the Properties of Plane Figures

1. Pre-test
2. Pretest answers
3. Lesson (pgs. 394-396)
4. Student practice
5. Posttest (no circles)
6. Characteristics of Circles (pg. 397)
   a. Can be done AFTER the posttest, since circles are not on the posttest.
   b. Perimeter and circumference are introduced on pgs. 397 and 398 as a “glimpse” of these concepts which will come in subsequent lessons.
Plane Figures Pre-test

1. A polygon with 4 sides and 4 corners
   - A. Rhombus
   - B. Square
   - C. Trapezoid
   - D. Quadrilateral

2. Opposite sides are the same length and parallel. There are 4 right angles.
   - A. Polygon
   - B. Trapezoid
   - C. Rectangle
   - D. Parallelogram

3. No sides are the same length
   - A. Square
   - B. Pentagon
   - C. Scalene triangle
   - D. Acute triangle

4. There are two pairs of parallel sides. Opposite sides are the same length.
   - A. Rhombus
   - B. Polygon
   - C. Parallelogram
   - D. Trapezoid

5. A polygon with 5 sides and 5 corners
   - A. Hexagon
   - B. Rhombus
   - C. Pentagon
   - D. Octagon

6. Has two pairs of parallel sides. All sides are the same length.
   - A. Rhombus
   - B. Quadrilateral
   - C. Trapezoid
   - D. Rectangle

7. All sides are the same length. Opposite sides are parallel. There are 4 right angles.
   - A. Rectangle
   - B. Trapezoid
   - C. Quadrilateral
   - D. Square

8. Triangle with one 90 degree angle
   - A. Acute triangle
   - B. Obtuse triangle
   - C. Right triangle
   - D. Isosceles triangle
Plane Figures Pre-test Answers

1. A polygon with 4 sides and 4 corners
   o A. Rhombus
   o B. Square
   o C. Trapezoid
   o D. Parallelogram

2. Opposite sides are the same length and parallel. There are 4 right angles.
   o A. Polygon
   o B. Trapezoid
   o D. Parallelogram

3. No sides are the same length
   o A. Square
   o B. Pentagon
   o D. Acute triangle

4. There are two pairs of parallel sides. Opposite sides are the same length.
   o A. Rhombus
   o B. Polygon
   o D. Trapezoid

5. A polygon with 5 sides and 5 corners
   o A. Hexagon
   o B. Rhombus
   o D. Octagon

6. Has two pairs of parallel sides. All sides are the same length.
   o B. Quadrilateral
   o C. Trapezoid
   o D. Rectangle

7. All sides are the same length. Opposite sides are parallel. There are 4 right angles.
   o A. Rectangle
   o B. Trapezoid
   o C. Quadrilateral

8. Triangle with one 90 degree angle
   o A. Acute triangle
   o B. Obtuse triangle
   o D. Isosceles triangle
OBJECTIVE A  To solve problems involving the perimeter of geometric figures

A **polygon** is a closed figure determined by three or more line segments that lie in a plane. The **sides of a polygon** are the line segments that form the polygon. The figures below are examples of polygons.

![Polygon Examples](image)

**Point of Interest**

Although a polygon is defined in terms of its sides (see the definition above), the word actually comes from the Latin word *polygonum*, which means "having many angles." This is certainly the case for many polygons.

![The Pentagon](image)

**The Pentagon in Arlington, Virginia**

A **regular polygon** is one in which each side has the same length and each angle has the same measure. The polygons in Figures A, C, and D above are regular polygons.

The name of a polygon is based on the number of its sides. The table below lists the names of polygons that have from 3 to 10 sides.

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Triangle</td>
</tr>
<tr>
<td>4</td>
<td>Quadrilateral</td>
</tr>
<tr>
<td>5</td>
<td>Pentagon</td>
</tr>
<tr>
<td>6</td>
<td>Hexagon</td>
</tr>
<tr>
<td>7</td>
<td>Heptagon</td>
</tr>
<tr>
<td>8</td>
<td>Octagon</td>
</tr>
<tr>
<td>9</td>
<td>Nonagon</td>
</tr>
<tr>
<td>10</td>
<td>Decagon</td>
</tr>
</tbody>
</table>

Triangles and quadrilaterals are two of the most common types of polygons. Triangles are distinguished by the number of equal sides and also by the measures of their angles.

![Triangle Examples](image)

**An isosceles triangle** has two sides of equal length. The angles opposite the equal sides are of equal measure.

\[
AC = BC \\
\angle A = \angle B
\]

**The three sides of an equilateral triangle** are of equal length. The three angles are of equal measure.

\[
AB = BC = AC \\
\angle A = \angle B = \angle C
\]

**A scalene triangle** has no two sides of equal length. No two angles are of equal measure.
An **acute triangle** has three acute angles.

An **obtuse triangle** has one obtuse angle.

A **right triangle** has a right angle.

Quadrilaterals are also distinguished by their sides and angles, as shown below. Note that a rectangle, a square, and a rhombus are different forms of a parallelogram.

The **perimeter** of a plane geometric figure is a measure of the distance around the figure. Perimeter is used in buying fencing for a lawn or determining how much baseboard is needed for a room.

The perimeter of a triangle is the sum of the lengths of the three sides.

**Perimeter of a Triangle**

Let \(a\), \(b\), and \(c\) be the lengths of the sides of a triangle. The perimeter, \(P\), of the triangle is given by \(P = a + b + c\).

**HOW TO:**

1. Find the perimeter of the triangle shown at the right.
2. \(P = a + b + c\)
3. \(= 3 \text{ cm} + 5 \text{ cm} + 6 \text{ cm}\)
4. \(= 14 \text{ cm}\)

The perimeter of the triangle is 14 cm.
The perimeter of a quadrilateral is the sum of the lengths of its four sides.

A rectangle has four right angles and opposite sides of equal length. Usually the length, \( L \), of a rectangle refers to the length of one of the longer sides of the rectangle, and the width, \( W \), refers to the length of one of the shorter sides. The perimeter can then be represented by \( P = L + W + L + W \).

The formula for the perimeter of a rectangle is derived by combining like terms:

\[ P = 2L + 2W \]

**Perimeter of a Rectangle**

Let \( L \) represent the length and \( W \) the width of a rectangle. The perimeter, \( P \), of the rectangle is given by \( P = 2L + 2W \).

**HOW TO 2** Find the perimeter of the rectangle shown at the right.

\[
P = 2L + 2W
\]

\[
= 2(6 \text{ m}) + 2(3 \text{ m})
\]

\[
= 12 \text{ m} + 6 \text{ m}
\]

\[
= 18 \text{ m}
\]

The perimeter of the rectangle is 18 m.

A square is a rectangle in which each side has the same length. Let \( s \) represent the length of each side of a square. Then the perimeter of the square can be represented by \( P = s + s + s + s \).

The formula for the perimeter of a square is derived by combining like terms.

**Perimeter of a Square**

Let \( s \) represent the length of a side of a square. The perimeter, \( P \), of the square is given by \( P = 4s \).

**HOW TO 3** Find the perimeter of the square shown at the right.

\[
P = 4s
\]

\[
= 4(3 \text{ ft})
\]

\[
= 12 \text{ ft}
\]

The perimeter of the square is 12 ft.
OBJECTIVE A  To solve problems involving the perimeter of geometric figures

For Exercises 1 to 4, name each polygon.

1. 
2. 
3. 
4. 

For Exercises 5 to 8, classify the triangle as isosceles, equilateral, or scalene.

5. 
6. 
7. 
8. 

For Exercises 9 to 12, classify the triangle as acute, obtuse, or right.

9. 
10. 
11. 
12. 

For Exercises 13 to 18, find the perimeter of the figure.

13. 
14. 
15. 

16. 
17. 
18.
Plane Figures Posttest

Write all the possible names for each quadrilateral. Choose from parallelogram, rhombus, square, and trapezoid.

1. ________  2. ________  3. ________  4. ________

Identify each polygon according to the number of sides.

5. ________  6. ________  7. ________  8. ________

9. ________  10. ________  11. ________  12. ________

13. ________  14. ________
Plane Figures Posttest

Write all the possible names for each quadrilateral. Choose from parallelogram, rhombus, square, and trapezoid.

1. parallelogram | rhombus | square
2. parallelogram | rhombus
3. parallelogram
4. trapezoid

Identify each polygon according to the number of sides.

5. quadrilateral
6. hexagon
7. octagon
8. quadrilateral
9. pentagon
10. triangle
11. hexagon
12. decagon

13. not a polygon
14. not a polygon
A circle is a plane figure in which all points are the same distance from point $O$, called the center of the circle.

The diameter of a circle is a line segment across the circle through point $O$. $AB$ is a diameter of the circle at the right. The variable $d$ is used to designate a diameter of a circle.

The radius of a circle is a line segment from the center of the circle to a point on the circle. $OC$ is a radius of the circle at the right. The variable $r$ is used to designate a radius of a circle.

The length of the diameter is twice the length of the radius. $d = 2r$ or $r = \frac{1}{2}d$.

The distance around a circle is called the circumference. The circumference, $C$, of a circle is equal to the product of $\pi$ (pi) and the diameter.

$$C = \pi d$$

Because $d = 2r$, the formula for the circumference can be written in terms of $r$.

$$C = 2\pi r$$

### Circumference of a Circle

The circumference, $C$, of a circle with diameter $d$ and radius $r$ is given by $C = \pi d$ or $C = 2\pi r$.

The formula for circumference uses the number $\pi$, which is an irrational number. The value of $\pi$ can be approximated by a fraction or by a decimal. $\pi \approx \frac{22}{7}$ or $\pi \approx 3.14$.

The $\pi$ key on a scientific calculator gives a closer approximation of $\pi$ than 3.14. Use a scientific calculator to find approximate values in calculations involving $\pi$.

#### HOW TO: 4

Find the circumference of a circle with a diameter of 6 in.

1. $C = \pi d$ • The diameter of the circle is given. Use the circumference formula that involves the diameter, $d = 6$ in.

2. $C = \pi(6\text{ in.})$ • The exact circumference of the circle is $6\pi$ in.

3. $C = 6\pi\text{ in.}$ • An approximate measure is found by using the $\pi$ key on a calculator.

The approximate circumference is 18.85 in.
EXAMPLE 1

A carpenter is designing a square patio with a perimeter of 44 ft. What is the length of each side?

Strategy
To find the length of each side, use the formula for the perimeter of a square. Substitute 44 for P and solve for s.

Solution
\[ P = 4s \]
\[ 44 = 4s \]
\[ 11 = s \]
The length of each side of the patio is 11 ft.

YOU TRY IT 1

The infield of a softball field is a square with each side of length 60 ft. Find the perimeter of the infield.

Your strategy

Your solution

EXAMPLE 2

The dimensions of a triangular sail are 18 ft, 11 ft, and 15 ft. What is the perimeter of the sail?

Strategy
To find the perimeter, use the formula for the perimeter of a triangle. Substitute 18 ft for a, 11 ft for b, and 15 ft for c. Solve for P.

Solution
\[ P = a + b + c \]
\[ P = 18 \text{ ft} + 11 \text{ ft} + 15 \text{ ft} \]
\[ P = 44 \text{ ft} \]
The perimeter of the sail is 44 ft.

YOU TRY IT 2

What is the perimeter of a standard piece of copier paper that measures 8 1/2 in. by 11 in.?

Your strategy

Your solution

EXAMPLE 3

Find the circumference of a circle with a radius of 15 cm. Round to the nearest hundredth.

Strategy
To find the circumference, use the circumference formula that involves the radius. An approximation is asked for; use the π key on a calculator. \( r = 15 \text{ cm} \).

Solution
\[ C = 2\pi r = 2\pi(15 \text{ cm}) = 30\pi \text{ cm} = 94.25 \text{ cm} \]
The circumference is approximately 94.25 cm.

YOU TRY IT 3

Find the circumference of a circle with a diameter of 9 in. Give the exact measure.

Your strategy

Your solution

Solutions on p. 518