## Investigating Polygons

What do we call a polygon with 4 sides? With 6 sides? With 8 sides?


## Explore



You will need a ruler and a protractor.
Your teacher will give you a large copy of these shapes.

## Mystery Sort!

Set 1: All of these shapes have the same attribute.


Set 2: None of these shapes has that attribute.


Set 3: Which of these shapes have that attribute?


Which attribute do the shapes in Set 1 share?

## Show and Share

Share your results with another pair of students.
Did you find the same attribute?
If not, check that both attributes are correct.
How did you decide which shapes in Set 3 have the attribute?
Which other shapes could you place in Set 1? Explain.

## Connect

A polygon is a closed shape with sides that are straight line segments.
Exactly 2 sides meet at a vertex. The sides intersect only at the vertices.
This shape is a polygon. These shapes are non-polygons.


A regular polygon has all sides equal and all angles equal.
These polygons are regular.




A regular polygon has line symmetry. A regular hexagon has 6 lines of symmetry.


## Math link

## Your World

A parfleche is a container used by the Plains people to carry dried meat, clothing, tools, and other goods. It is usually made from buffalo hide, then painted with a design. The design represents a particular band, and is passed down from generation to generation. Which polygons do you see in the design on this
 parfleche of the Crow Nation?

An irregular polygon does not have all sides equal and all angles equal.
These polygons are irregular.


A convex polygon has all angles less than $180^{\circ}$.
These polygons are convex.


A concave polygon has at least one angle greater than $180^{\circ}$.
These polygons are concave.


## Practice

1. Explain why each shape is not a polygon.
a)

b)

2. Is each polygon regular? How do you know?
a)

b)

c)

3. A cell in a honeycomb approximates a regular hexagon.
a) Suppose $\angle A=120^{\circ}$. What are the measures of angles $B, C, D, E$, and $F$ ?
b) Suppose side $A B$ has length 9 cm .

What are the lengths of sides $\mathrm{BC}, \mathrm{CD}, \mathrm{DE}, \mathrm{EF}$, and FA ?
4. Your teacher will give you a large copy of these shapes.
a) Sort these shapes into sets of polygons and
 non-polygons. Explain how you decided where to place each shape.

b) Draw a different shape that belongs in each set. Explain how you know that it belongs.
5. Your teacher will give you a large copy of these polygons.

a) Which polygons appear to be regular?
b) How can you check that the polygons you identified in part a are regular? Use your strategy to check.
c) Sort the polygons into sets of regular and irregular polygons.
d) For each set in part c, draw a different polygon that belongs in that set.
e) Sort the polygons into sets of convex and concave polygons.
f) For each set in part e, draw a different polygon that belongs in that set.
6. Your teacher will give you a large copy of these road signs.

a) Name the polygon that each sign reminds you of.
b) Sort the signs into sets of regular and irregular polygons. Explain how you did this.
7. a) Find at least 3 different irregular polygons outside the classroom. Describe each polygon you find.
b) Find at least 3 different regular polygons outside the classroom.

Describe each polygon you find.
Name each polygon.
8. a) What do we call:

- a regular triangle?
- a regular quadrilateral?
b) Use dot paper.

Draw 3 different regular triangles.
Draw 3 different regular quadrilaterals.
c) What do you notice about the regular triangles you drew?

What do you notice about the regular quadrilaterals you drew?
9. Can a concave quadrilateral be regular?

Explain.

## Reflect

List the attributes of a regular polygon.
Which strategy do you prefer to use to check whether a polygon is regular or irregular?
Explain your choice.

## Congruence in Regular Polygons

Do these shapes match? How could you find out?


## Explore



You will need tracing paper, a protractor, and a millimetre ruler.
Your teacher will give you a large copy of these polygons.

> Identify pairs of polygons that match.
How do you know that they match?
> Choose a pair of matching polygons. Measure and record their side lengths. Measure and record their angles.
Repeat these measures for other pairs of matching polygons.

- What do you notice about the side lengths and angle measures of matching polygons? Explain.


## Show and Share

Share your work with another pair of students.
Check that you found the same pairs of matching polygons. What other strategy could you use to tell if two polygons match?

## Connect

When polygons match exactly, the polygons are congruent.
Here are two ways to show that these pentagons are congruent.


- Place one pentagon on top of the other.

If they match exactly, they are congruent.
You may need to flip or turn the shapes to show they are congruent.
If you cannot move the pentagons:
Trace one pentagon, then place the tracing on top of the other pentagon.

When one shape is placed on top of another and the two shapes match exactly, we say they coincide. One shape is superimposed on the other.


Measure and record the lengths of all the sides.
Measure and record all the angle measures.


Compare the measures.

All sides have the same length.
$\mathrm{AB}=\mathrm{BC}=\mathrm{CD}=\mathrm{DE}=\mathrm{EA}=\mathrm{FG}=\mathrm{GH}=\mathrm{HJ}=\mathrm{JK}=\mathrm{KF}$
All angles have the same measure.

We use the word congruent to describe equal sides and equal angles.


Use hatch marks and symbols to show the equal sides and equal angles.

In pentagons ABCDE and FGHJK, all sides are equal and all angles are equal.
So, the pentagons are congruent.
We say: "Pentagon ABCDE is congruent to pentagon FGHJK."

Since all sides and angles are equal, we start with any vertex, then write the vertices in a clockwise or counterclockwise order.

Here is a regular octagon.
We can use a tracing of the octagon to show that all sides are equal and all angles are equal.
> Trace the octagon.
Place the tracing to coincide with the octagon.


Each angle in the tracing fits exactly over an angle in the original octagon.
Each side in the tracing fits exactly over a side in the original octagon.

Rotate the tracing until the octagons coincide again.
Keep rotating until you have checked every side and every angle.
Then you know that all the angles are congruent, and all the sides are congruent.


## Practice

1. Quadrilaterals DEFG and JKMN are congruent.
a) Without using a protractor, write the measure of each angle in JKMN.
b) Without using a ruler, write the length of each side in JKMN.

2. Which of these polygons are congruent?

How can you tell?

3. a) Use tracing paper. Trace hexagon HJKLMN on paper.

Label the vertices of the traced hexagon UVWXYZ.

b) Find the side lengths and angle measures of both hexagons. What do you notice?
4. Your teacher will give you a large copy of these polygons. Use whatever materials you need.

a) Which pairs of polygons have corresponding angles congruent? Which strategy did you use to find out?
b) Which pairs of polygons have corresponding sides congruent? Which strategy did you use to find out?
c) Which pairs of polygons in parts $a$ and $b$ are congruent? How did you decide?
Show your work.
5. Work with a partner. You will need tracing paper and a ruler. Each of you draws a triangle. Use tracing paper to draw 2 exact copies of the triangle in different orientations. Trade triangles with your partner.
Check that your partner's triangles are congruent. Which strategy did you use to check?
6. Draw a regular hexagon on triangular dot paper. Use measuring and superimposing to show that all angles are congruent and all sides are congruent.
 Show your work.
7. A student drew a rectangle on grid paper.

The student said, "Since all the angles measure $90^{\circ}$, the angles are congruent. So, the rectangle is a regular quadrilateral."
Do you agree? Why or why not?

## Reflect

What does it mean when we say two regular polygons are congruent? Include diagrams in your explanation.

