Getting To Know Quadrilaterals

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Target Grade: Geometry

Time Required: 75 minutes

Standards

Tennessee State Standard for Geometry:

- **G.MG.A.1 (Major)** (IFD) Use geometric shapes, their measures, and their properties to describe objects.

Lesson Objectives

Students will:

- Describe and classify different quadrilaterals using their properties
- Use academic vocabulary to describe the properties of quadrilaterals

Central Focus

Quadrilaterals are all around us! In one activity, the students will match the names of quadrilaterals to shapes they see in their everyday lives. In addition, this lesson incorporates analytical thinking about how to represent relationships between concepts. As the students build their graphic organizers, they will learn the skills of categorization and classification. The examples of graphic organizers will show students how these skills are useful in everyday life to help them organize their thinking on any topic.

Key Terms: quadrilateral, polygons, diagonal, bisect, right angle, congruent, parallel, perpendicular, supplementary, parallelogram, rectangle, rhombus, square, kite, trapezoid, isosceles trapezoid

Background Information

This lesson builds on the students' prior knowledge of quadrilaterals as polygons. It also uses prior knowledge of the following terms: diagonal, bisect, right angle, congruent, parallel, perpendicular, and supplementary. The students will have already learned these terms and learned how to use symbols to represent some of these terms. For example, the students will know that tick and arc marks are used to show congruence between line segments and angles.

The teacher will need to have knowledge of the properties of each quadrilateral as well as how to classify them.

- Quadrilateral
  - Four sided polygon with four edges and four vertices

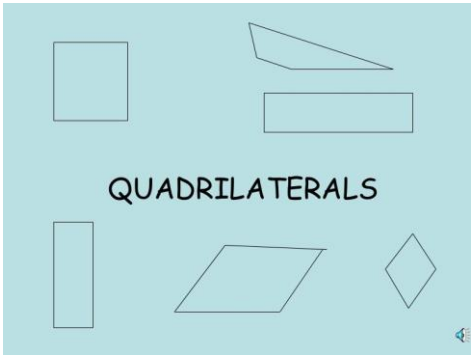


Figure 1: https://www.slideshare.net/khenkels/quadrilateral

- Parallelogram
  - Opposite sides are congruent
  - Opposite sides are parallel
  - Opposite angles are congruent
  - Consecutive angles are supplementary
  - Diagonals bisect each other
  - One pair of sides is both parallel and congruent

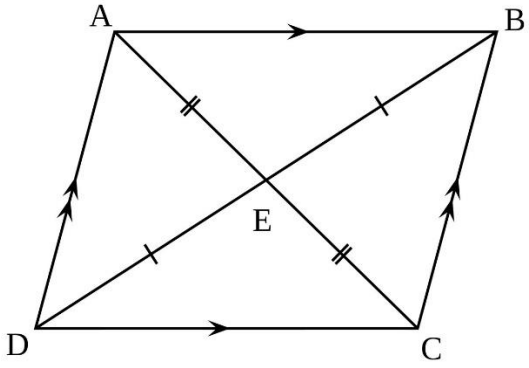


Figure 2: https://tutors.com/math-tutors/geometry-help/what-is-a-parallelogram-definition-properties

- Rectangle
  - A parallelogram with four congruent angles, which each measure 90 degrees
  - Diagonals are congruent

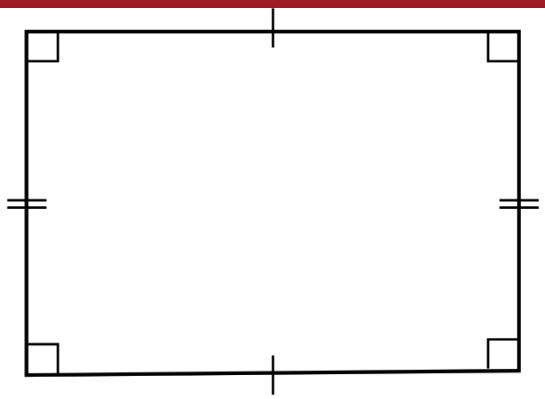


Figure 3: https://en.wikipedia.org/wiki/Rectangle

- Rhombus
  - A parallelogram with four congruent sides
  - The diagonals are perpendicular bisectors of each other
  - Each diagonal bisects a pair of opposite angles

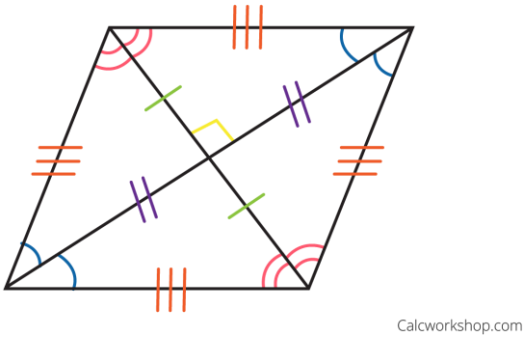


Figure 4: https://calcworkshop.com/quadrilaterals/quadrilateral-properties/

- Square
  - A parallelogram for which all sides and angles are congruent

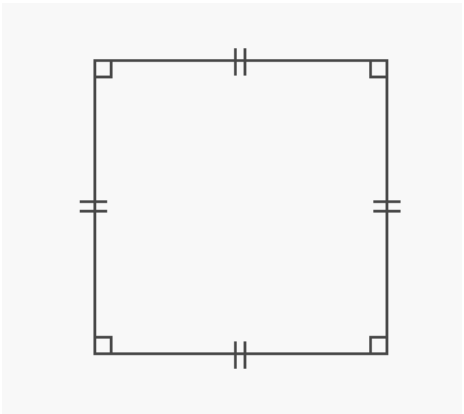


Figure 5: https://www.splashlearn.com/math-vocabulary/geometry/square

- Kite
  - A quadrilateral with two pairs of opposite sides that are congruent

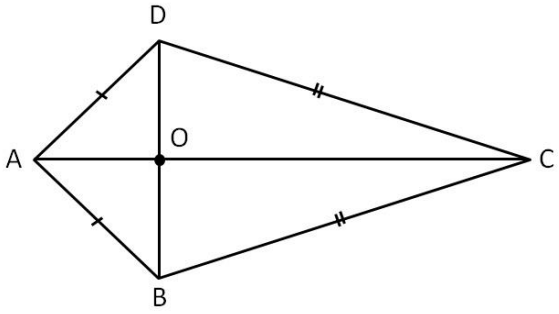


Figure 6: https://www.teachoo.com/8596/2790/Kite/category/Types-of-Quadrilaterals/

- Trapezoid
  - A quadrilateral with exactly one pair of parallel sides

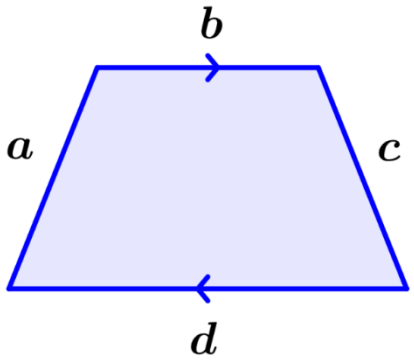


Figure 7: https://www.mechamath.com/geometry/properties-of-a-trapezoid/

- Isosceles Trapezoid
  - A trapezoid for which the legs are congruent
  - Each pair of base angles is congruent
  - Diagonals are congruent

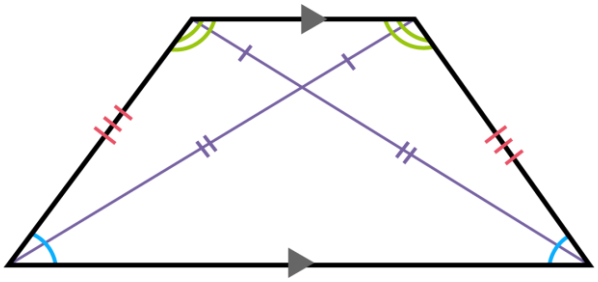


Figure 8: https://calcworkshop.com/quadrilaterals/trapezoid-properties/

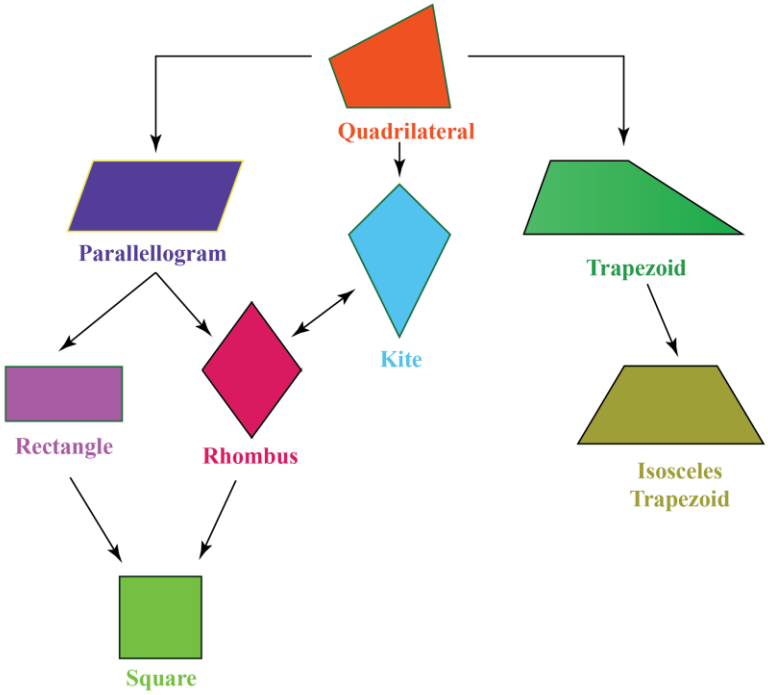


Figure 9 https://www.cuemath.com/geometry/quadrilaterals/

The teacher will also need to be familiar with the following terms: diagonal, bisect, right angle, congruent, parallel, perpendicular, and supplementary.

- Diagonal
  - A polygon's diagonals are line segments from one corner to another (but not the edges). (Diagonals of Polygons (mathsisfun.com))

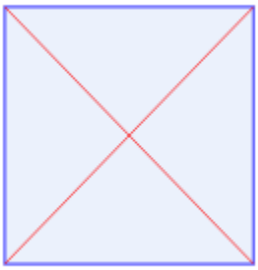


Figure 10: Diagonals of Polygons (mathsisfun.com)

- Bisect
  - Bisect means to divide into two equal parts. (Bisect (mathsisfun.com))

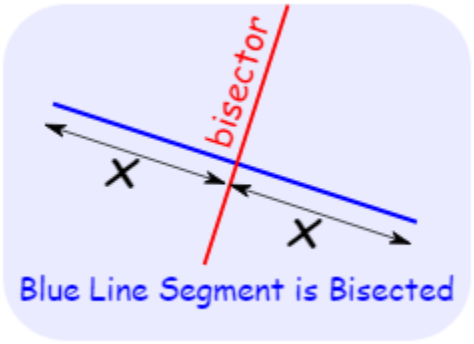


Figure 11: https://www.mathsisfun.com/geometry/bisect.html

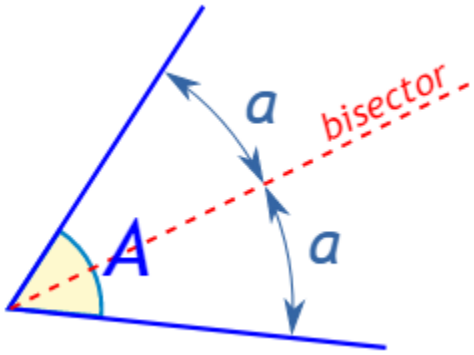


Figure 12: https://www.mathsisfun.com/geometry/bisect.html

- Right Angle
  - A right angle is an internal angle which is equal to 90 degrees. (Right Angles (mathsisfun.com))

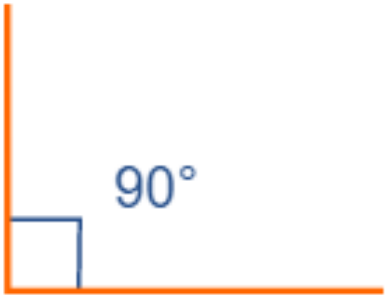


Figure 13: https://www.mathsisfun.com/rightangle.html

- Congruent
  - Congruent means equal.
  - Angles are congruent when they are the same size (in degrees or radians).
  - Sides are congruent when they are the same length. (Congruent Definition (Illustrated Mathematics Dictionary) (mathsisfun.com))

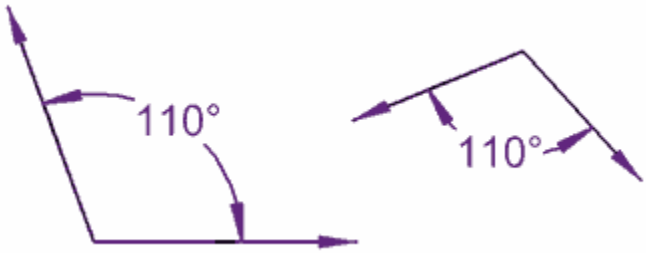


Figure 14: https://www.mathsisfun.com/geometry/congruent-angles.html

- Parallel
  - Lines are parallel if they are always the same distance apart (called “equidistant”), and will never meet (they also point in the same direction). (Perpendicular and Parallel (mathsisfun.com))

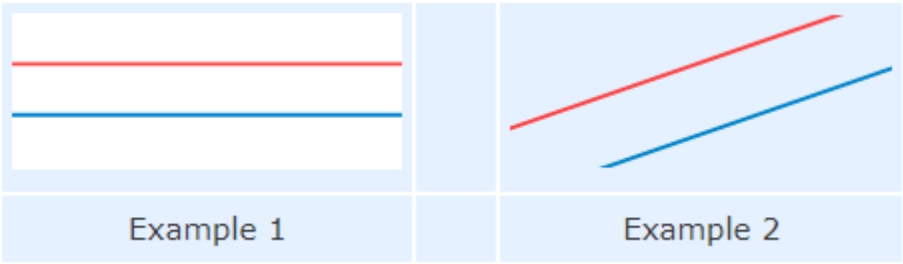


Figure 15: https://www.mathsisfun.com/geometry/parallel-lines.html

- Perpendicular
  - It means at right angles (90 degrees) to. (Perpendicular and Parallel (mathsisfun.com))

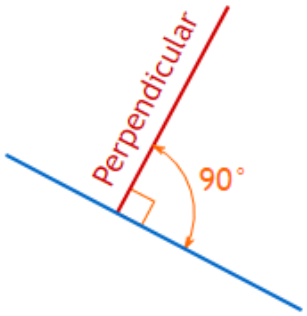


Figure 16: https://www.mathsisfun.com/perpendicular-parallel.html

- Supplementary
  - Two angles are supplementary when they add up to 180 degrees. (Supplementary Angles (mathsisfun.com))

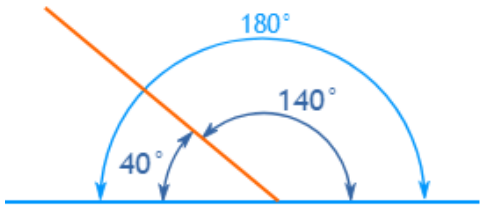


Figure 17: https://www.mathsisfun.com/geometry/supplementary-angles.html

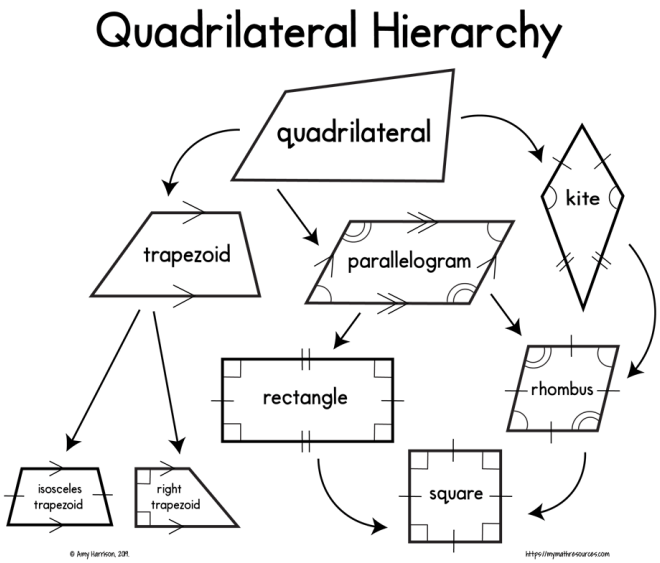
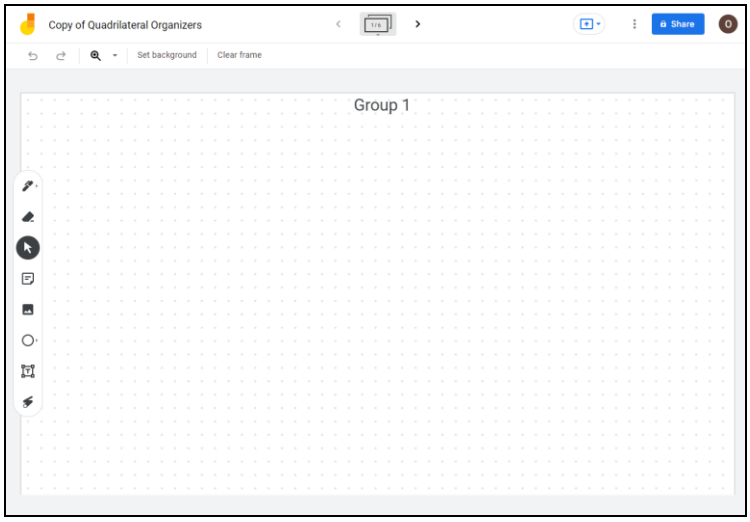


Figure 18 https://mymathresources.com/product/quadrilateral-hierarchy-poster-bulletin-board-anchor-chart-5-g-b-3-5-g-b-4/

Materials

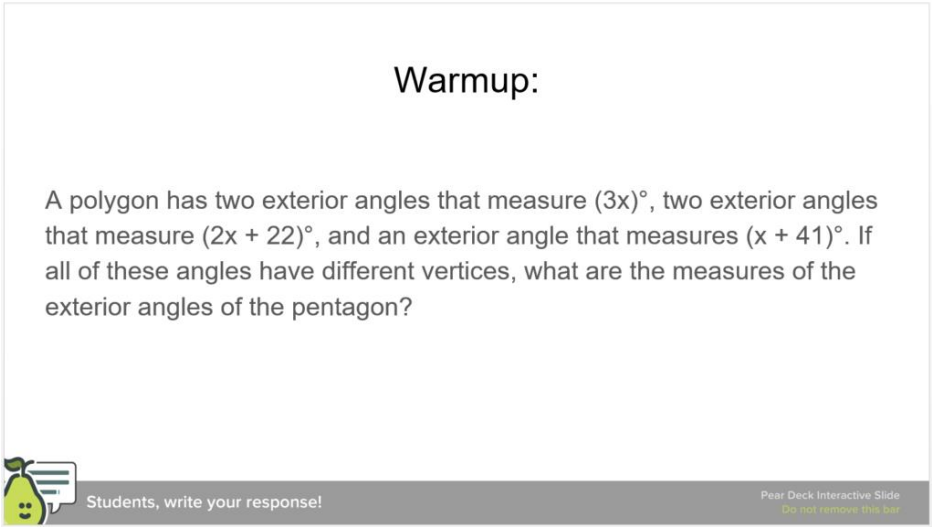
- Quadrilateral Properties Table
- Computer (1 per student, at least 1 per group)
- Pear Deck Presentation: https://docs.google.com/presentation/d/17S5caOLeb_kh5YorbwUr4ukPWs_djqfnQdPQ_Fe2k2A/copy
    - Pear Deck is a website where students can engage in learning through participation. Students are able to draw on the slides and type when instructed throughout the presentation.
    - Go to: https://www.peardeck.com/ and use the presentation above.
- JamBoard: https://jamboard.google.com/d/10UmFRYmlugNsDivdVgu59-56EKUw-_JQNSuXkDDkWFI/copy
    - JamBoard is a website that students can participate by typing their thoughts, ideas, or questions. Students can also draw on JamBoard.



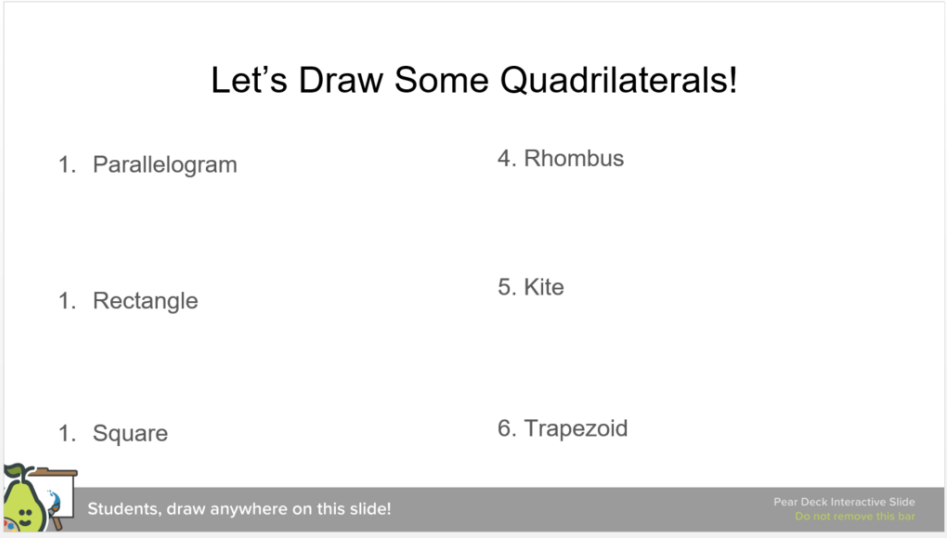
Instruction

Introduction (15 minutes)

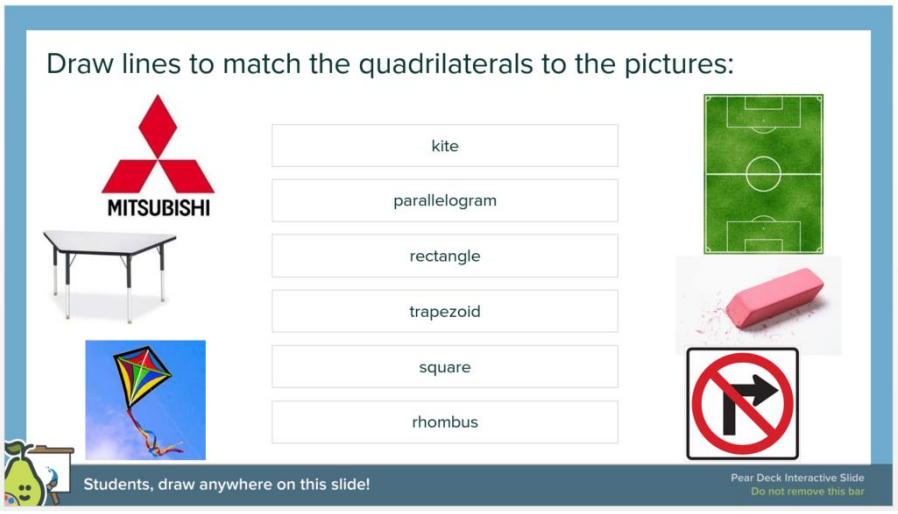
- Use the Pear Deck presentation and instruct the students to start with the warmup problem about the exterior angles of a pentagon.
    - To answer the warmup questions, students must apply their knowledge of the exterior angles of polygons and the number of angles in each polygon to solve for each angle measure.



- Once the students have worked to solve this problem, they will reflect on what they know about quadrilaterals.
    - Students may mix up the sum of the interior angles with the sum of the exterior angles, students may forget that quadrilaterals have 4 sides.
- Instruct students to draw (on peardeck) each quadrilateral.



- Once the students are done, move on to the next slide and have the students identify quadrilaterals in everyday objects.



- Once the students are done, have a whole class discussion about what they drew. Students will begin describing objects by naming them.

Activity (50 minutes):

- Hand out the quadrilateral table worksheet to the students.
- Ask the students to individually analyze and interpret the diagrams. Have them fill out the definition or property using the information provided in the diagram.
    - Students must analyze diagrams to identify the information that is being communicated in each image.
    - As students fill out the table, they are learning the properties of quadrilaterals that they can use to describe them.
    - The students may mix up the symbols for congruent line segments and parallel segments, the students may think all trapezoids are isosceles trapezoids, the students may think that if lines are parallel that they must be congruent.
- After filling out the table, the students will answer some multiple-choice questions on peardeck to assess whether they understand the properties using the table they filled out.
    - Rectangles are _____ parallelograms.
        - a. always
        - b. sometimes
        - c. never
    - Parallelograms are _____ squares.
        - a. always
        - b. sometimes
        - c. never
    - Squares are _____ trapezoids.
        - a. always
        - b. sometimes
        - c. never

- After they answer the questions, the students will work in groups of 3-4 to create a graphic organizer that categorizes or classifies the quadrilaterals. Each group will use a separate JamBoard slide. Their organizer can be a Venn Diagram, a flowchart, a family tree, etc.
    - Students must include the terms:
        - Quadrilateral
        - Rhombus
        - Kite
        - Trapezoid
        - Rectangle
        - Parallelogram
        - Square
        - Isosceles Trapezoid
    - Students must synthesize the information on the table into an organizer that depicts the relationships between the different quadrilaterals.
    - When the students create and justify their graphic organizers, they will use the properties they learned to describe the various quadrilaterals and how they relate.

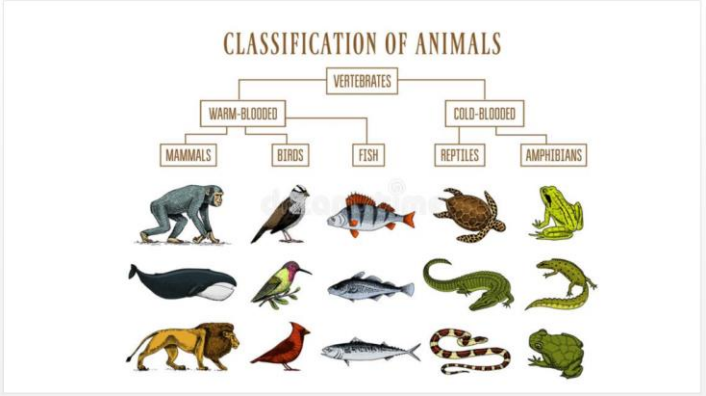


Figure 19: Example of a Family Tree

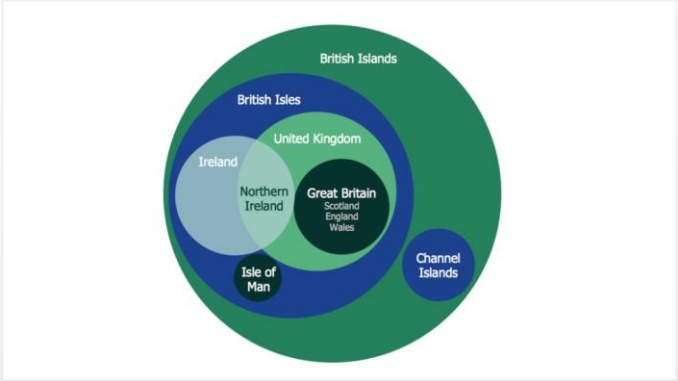


Figure 20: Example of a Venn Diagram

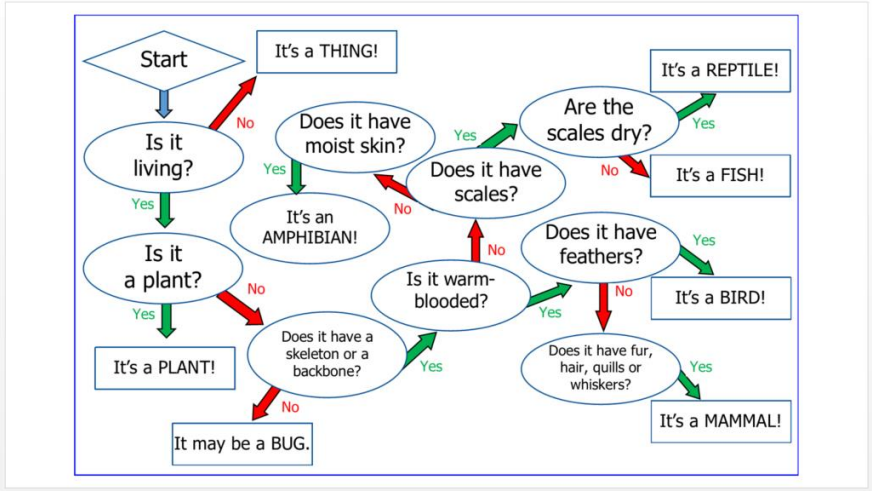
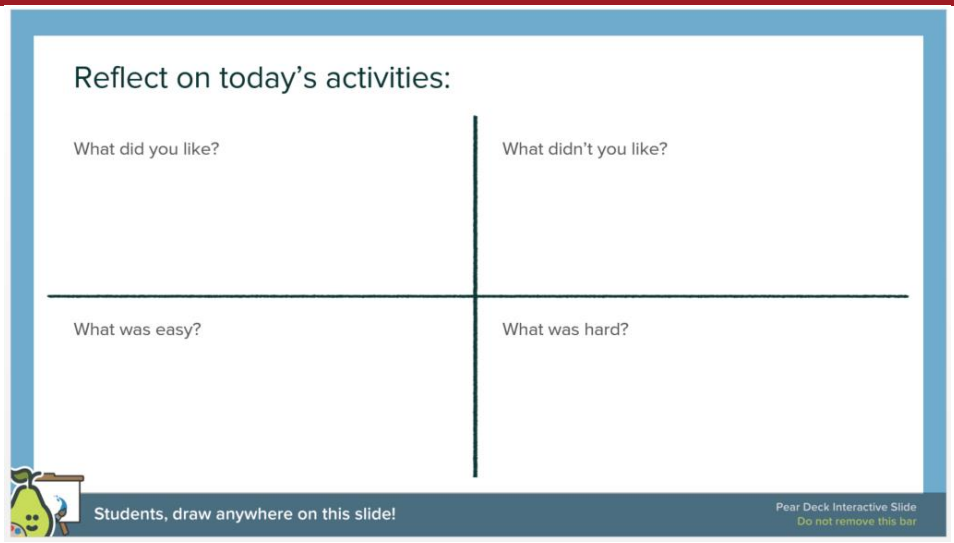


Figure 21: Example of a Flow Chart

- As the students work on the organizers, the teacher will walk around the room and monitor each group's work. One or two groups will be selected to justify their graphic organizers in a final whole class discussion.
- Throughout the activity, here are some questions to ask your students:
    - How many angles are in a pentagon? What is the sum of the exterior angles? Does this sum change based on the number of sides? How many sides does a quadrilateral have?
    - If two lines form a right angle, what term describes the lines?
    - What do the arrows, ticks, and arc marks mean?
    - If we have a point that divides a segment into two equal parts, what do we call the point?
    - How do you know that a square is a parallelogram?
    - How do you know that a square is never a trapezoid?
    - How can you represent the relationships between these quadrilaterals?
    - How do we read graphic organizers?
    - What does "congruent" mean?
    - If we have a right angle, what do we know about the lines?
    - How does your organizer show the relationships between these shapes? How can I read your organizer? How does your organizer tell me that a rectangle is always a parallelogram?

Conclusion (5 minutes):

- The class will end will the students reflecting about the lesson on the final Pear Deck slide.
    - This final reflection allows time for students to self-reflect on their learning.
    - It incorporates principles of metacognition in which students think about their thinking and recognize what they know and do not know.



Differentiation

Grouping

- Each student will be required to fill out their own table, although they may check their answers with their group.
- The groups will be heterogeneous so that students can support one another's learning.

ELL students

- Provide the students with a translation of the terms used in the lesson.
- Allow the students to use an online translator.
- Students may draw pictures instead of written or typed answers.

Students who are struggling

- During the interactive activities, the teacher can make sure to monitor any students who are struggling and give support when needed.
- If needed, the students may also use the internet to research the shapes or look up words.
- If needed, the teacher can provide a blank flow chart or Venn diagram that a group can simply fill in. This provided organizer will already have the correct layout, so the students do not have to create this layout themselves.
- Students may get out their notes from the previous days to help them with this section.
- Students may draw pictures or type text to answer the reflection questions.

Advanced Students

- The students can write in their own words how to classify each type of quadrilateral.
- The student can have the option to work individually on the graphic organizer.

Assessment

Formative Assessment

- The discussions in class will allow the teacher to assess what the students understood throughout the lesson.
- As the students work individually and in groups, the teacher will be walking around to listen into the discussions and asking the students questions. This will allow the teacher to assess the students' understanding of quadrilaterals.

Summative Assessment

- The group work activities as well as the final reflection will allow the teacher to assess the students' understanding of the different properties of quadrilaterals.
    - If the students struggled to organize their thinking of these properties, they will begin the next class by filling out a table in which the students check off the properties by each quadrilateral so that they can better visualize which properties the shapes share.

Warmup:

A polygon has two exterior angles that measure (3x)°, two exterior angles that measure (2x + 22)°, and an exterior angle that measures (x + 41)°. If all of these angles have different vertices, what are the measures of the exterior angles of the pentagon?

Students, write your response!

Pear Deck Interactive Slide
Do not remove this bar

Can you remember the names of specific quadrilaterals?

Students, write your response!

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Let’s Draw Some Quadrilaterals!

1. Parallelogram

1. Rectangle

1. Square

4. Rhombus

5. Kite

6. Trapezoid

Students, draw anywhere on this slide!

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Draw lines to match the quadrilaterals to the pictures:

kite

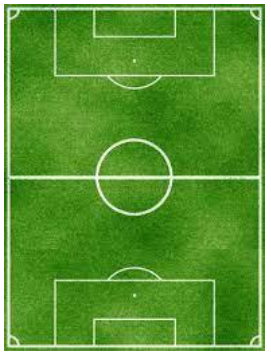
parallelogram

rectangle

trapezoid

square

rhombus



Students, draw anywhere on this slide!

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Quadrilateral Table

1. Analyze and interpret the diagrams.
    a. What information does the diagram give you?
2. Fill out the definition or property using the information provided in the diagram.

Rectangles are _____ parallelograms.

Students choose an option

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Parallelograms are _____ squares.

Students choose an option

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Squares are _____ trapezoids.

Students choose an option

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For this activity you will...

Make a graphic organizer of these quadrilaterals with your group on Jamboard (Quadrilateral Organizers)

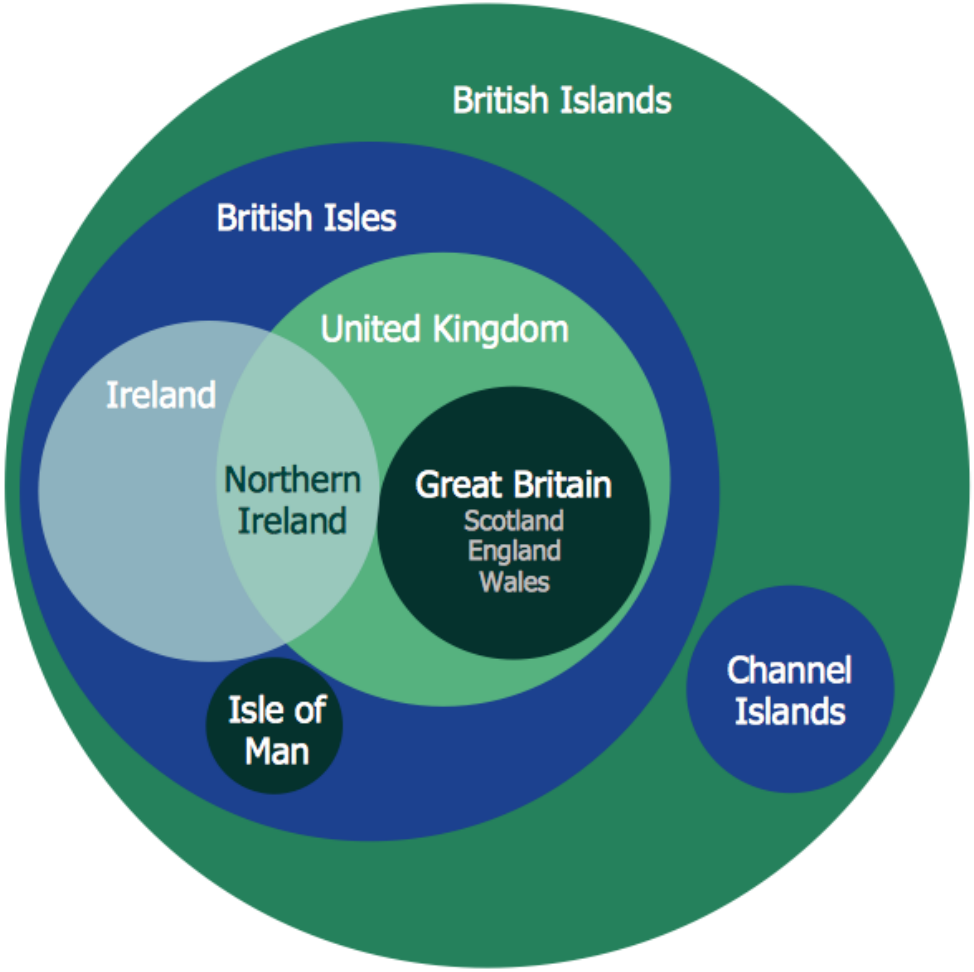
Include the following terms:

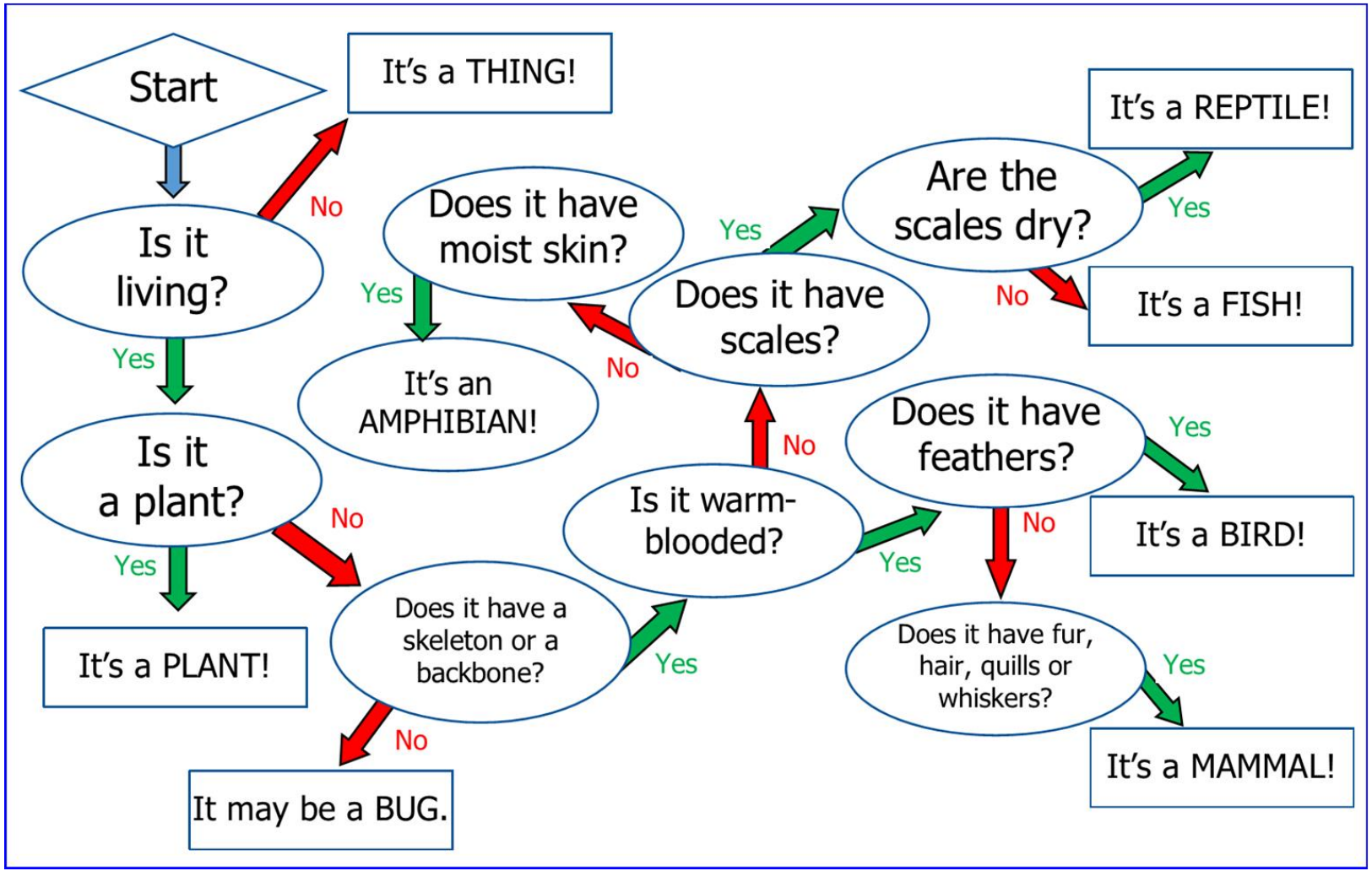
Quadrilateral, rhombus, kite, trapezoid, rectangle, parallelogram, square, isosceles trapezoid

If you finish early, go to other group's slides and use the sticky notes to make comments about things you like or things you are confused about in their organizer.

CLASSIFICATION OF ANIMALS

- VERTEBRATES
  - WARM-BLOODED
    - MAMMALS
    - BIRDS
    - FISH
  - COLD-BLOODED
    - REPTILES
    - AMPHIBIANS


British Islands
British Isles
United Kingdom
Ireland
Northern Ireland
Great Britain
Scotland
England
Wales
Isle of Man
Channel Islands


Start
Is it living?
No
It's a THING!
Yes
Is it a plant?
No
Yes
It's a PLANT!
Does it have a skeleton or a backbone?
No
It may be a BUG.
Yes
Does it have moist skin?
Yes
It's an AMPHIBIAN!
No
Is it warm-blooded?
Yes
No
Does it have scales?
Yes
Are the scales dry?
Yes
It's a REPTILE!
No
It's a FISH!
Does it have feathers?
Yes
It's a BIRD!
No
Does it have fur, hair, quills or whiskers?
Yes
It's a MAMMAL!

Reflect on today's activities:

What did you like?

What didn't you like?

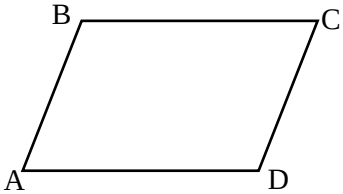
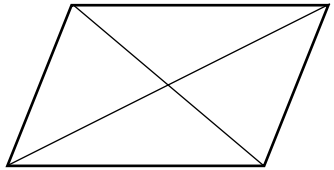
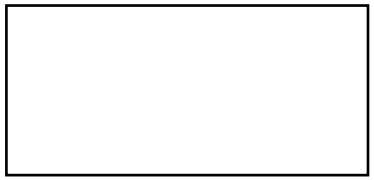
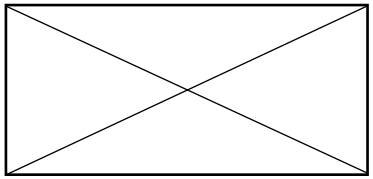
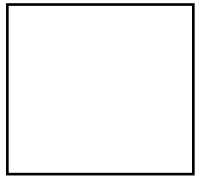
What was easy?

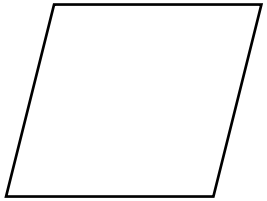
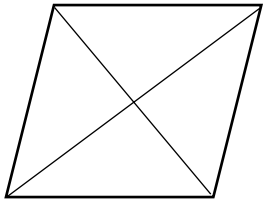
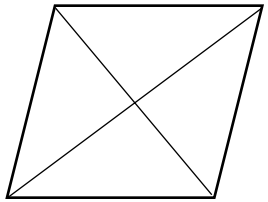
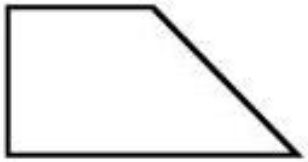
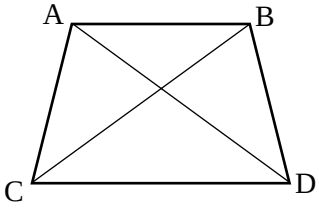
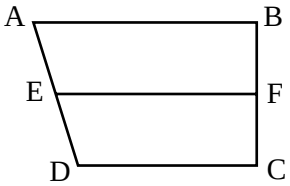
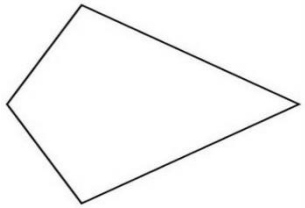
What was hard?

Students, draw anywhere on this slide!

Pear Deck Interactive Slide
Do not remove this bar

Quadrilaterals and their Properties

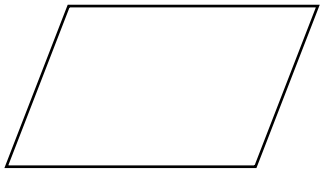
 Def: A parallelogram is a quadrilateral for which the opposite sides are _____.	 A quadrilateral is a parallelogram if and only if its opposite sides are _____.	 A quadrilateral is a parallelogram if and only if its opposite angles are _____.
 $m\angle A + m\angle B = 180°$ $m\angle A + m\angle D = 180°$ If a quadrilateral is a parallelogram, then its consecutive angles are _____.	 A quadrilateral is a parallelogram if and only if its diagonals _____ each other.	 If one pair of sides of a quadrilateral is both _____ and _____, then it is a parallelogram.
 **Def:** A rectangle is a parallelogram with four congruent angles, which each measure _____.	 A rectangle's diagonals are _____.	 **Def:** A square is a parallelogram for which all sides and angles are _____.

 **Def:** A rhombus is a parallelogram with four _____ sides.	 In a rhombus, the diagonals are _____ bisectors of each other.	 In a rhombus, each diagonal _____ a pair of opposite angles.
 **Def:** A trapezoid is a quadrilateral with exactly one pair of _____ sides.	 **Def:** An isosceles trapezoid is a trapezoid for which the legs are _____.	 In an isosceles trapezoid, each pair of base angles is _____.
 In an isosceles trapezoid, the diagonals are _____.	 $EF = \frac{AB + BC}{2}$ **Def:** The median of a trapezoid is a segment whose endpoints are the _____ of the legs of the trapezoid. The median is _____ to the bases and its length is _____ of the sum of the bases.	 **Def:** A kite is a quadrilateral with two pairs of _____ sides that are congruent.

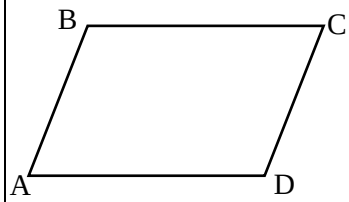
Quadrilaterals and their Properties KEY

Def: A parallelogram is a quadrilateral for which the opposite sides are congruent.

A quadrilateral is a parallelogram if and only if its opposite sides are parallel.



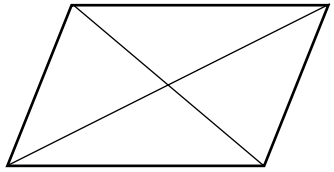
A quadrilateral is a parallelogram if and only if its opposite angles are congruent.



$m\angle A + m\angle B = 180°$

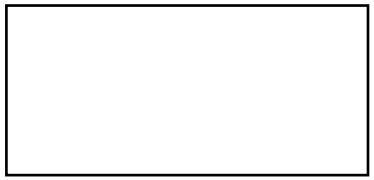
$m\angle A + m\angle D = 180°$

If a quadrilateral is a parallelogram, then its consecutive angles are Supplementary.

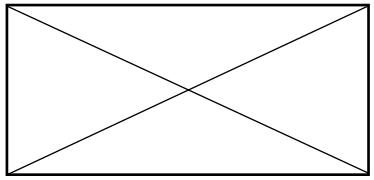


A quadrilateral is a parallelogram if and only if its diagonals bisect each other.

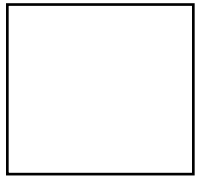
If one pair of sides of a quadrilateral is both parallel and congruent, then it is a parallelogram.



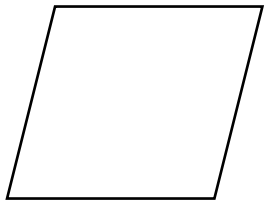
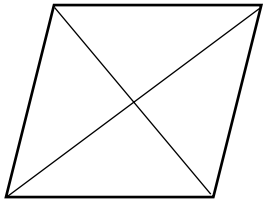
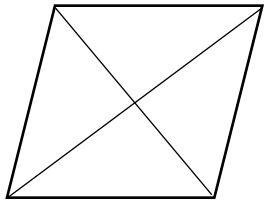
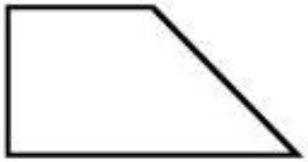
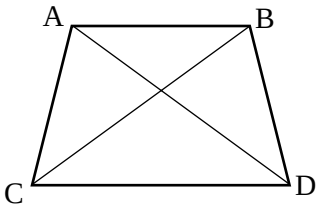
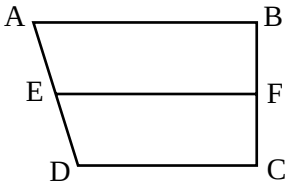
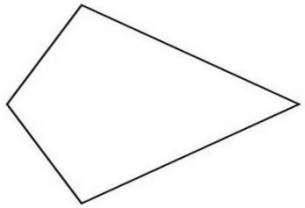
Def: A rectangle is a parallelogram with four congruent angles, which each measure 90 degrees.



A rectangle's diagonals are congruent.



Def: A square is a parallelogram for which all sides and angles are congruent.

 **Def:** A rhombus is a parallelogram with four congruent sides.	 In a rhombus, the diagonals are perpendicular bisectors of each other.	 In a rhombus, each diagonal bisect a pair of opposite angles.
 **Def:** A trapezoid is a quadrilateral with exactly one pair of parallel sides.	 **Def:** An isosceles trapezoid is a trapezoid for which the legs are congruent.	 In an isosceles trapezoid, each pair of base angles is congruent.
 In an isosceles trapezoid, the diagonals are congruent.	 $EF = \frac{AB + BC}{2}$ **Def:** The median of a trapezoid is a segment whose endpoints are the midpoints of the legs of the trapezoid. The median is parallel to the bases and its length is half of the sum of the bases.	 **Def:** A kite is a quadrilateral with two pairs of opposite sides that are congruent.