

Activity 21

Constructing Quadrilaterals

Objectives

- To learn how to construct all types of quadrilaterals using the Cabri® Jr. application
- To reinforce the difference between a construction and a drawing

Cabri® Jr. Tools











Introduction


The difference between a construction and a drawing is an important distinction in a dynamic geometry environment. (See “A General Interactive Geometry Issue” on page v.) In this activity, you will construct different types of quadrilaterals from the quadrilateral hierarchy. This activity asks for constructions based on a minimal definition of the quadrilateral.

Construction

Construct the following (each as a separate Cabri Jr. figure) using the given minimal definitions.

-  **Quadrilateral** — a four-sided polygon
-  **Kite** — a quadrilateral with two distinct pairs of consecutive congruent sides
-  **Trapezoid** — a quadrilateral with at least one pair of parallel sides
-  **Isosceles trapezoid** — a trapezoid with one pair of congruent base angles
-  **Parallelogram** — a quadrilateral with two pairs of parallel sides
-  **Rhombus** — a quadrilateral with four congruent sides
-  **Rectangle** — a quadrilateral with three right angles
-  **Square** — a quadrilateral with four congruent sides and one right angle

Exploration

-  Drag the vertices and sides of the quadrilaterals you have constructed to ensure the minimal definitions are retained.

Note: In some constructions, not all vertices or sides are independent points that will drag.

Questions and Conjectures

Write the steps you used to construct each of the quadrilaterals. Be prepared to demonstrate that your construction supports the minimal definition.

Teacher Notes



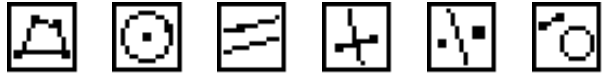
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Additional Information

For this activity, you may want to demonstrate one construction for the students so they understand what to do.

The Cabri Jr. tools listed under the objectives are there to offer suggestions to the students as tools that they might want to consider using. Students are not required to use every one of these tools nor are they limited to only these tools.

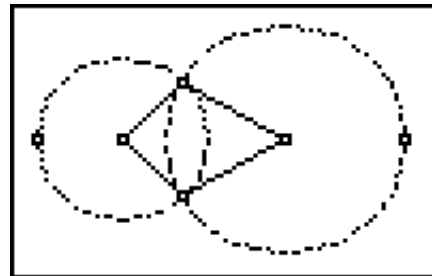
Answers to Questions and Conjectures

Write the steps you used to construct each of the quadrilaterals. Be prepared to demonstrate that your construction supports the minimal definition.

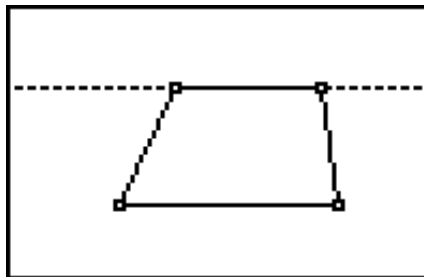
Possible quadrilateral constructions based on minimal definitions are given below.

Quadrilateral: The **Quadrilateral** tool constructs, in the sense of this activity, a general quadrilateral.

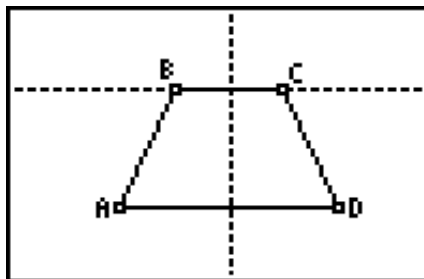
Kite: Construct two circles having different radii on the screen that intersect at two points (not their radii points). Use the **Quadrilateral** tool to construct a kite using the centers and intersection points of the two circles. This construction is valid because the radii of a circle are congruent and the radii of the two circles are independent of each other.



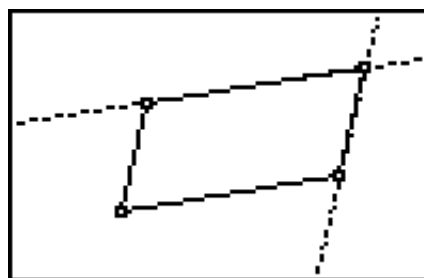
Trapezoid: Construct a segment and a point not on the segment. Use the **Parallel** tool to construct a line parallel to the segment through the point. Construct a trapezoid using the endpoints of the segment, the constructed point, and any other point on the parallel line. This construction is valid since the only property of a trapezoid is that one pair of sides are parallel.



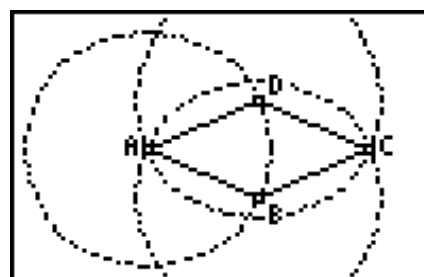
Isosceles trapezoid: Construct \overline{AD} and point B not on \overline{AD} . Use the **Parallel** tool to construct a line parallel to the segment through point B . Construct the perpendicular bisector of \overline{AD} and use the **Reflection** tool to reflect point B across the perpendicular bisector of \overline{AD} to establish the position of point C , the fourth vertex of the isosceles trapezoid. Use the **Quadrilateral** tool to overlay a quadrilateral finishing the construction. The construction is valid because of the properties of a perpendicular bisector and a line reflection. Note that it is not necessary to generate the line parallel to \overline{AD} since \overline{BC} is parallel to \overline{AD} and because line reflections are perpendicular to the mirror, which in this case is perpendicular to \overline{AD} . Points A and D can be considered reflections of each other because of the properties of a line reflection. Reflecting point B over the perpendicular bisector can then be considered the same as reflecting $\angle BAD$ to create $\angle CDA$. Since angle measure is preserved under a line reflection, $\angle BAD \cong \angle CDA$, as the minimal definition requires.



Parallelogram: Construct two segments with a common endpoint. Use the **Parallel** tool to construct lines parallel to the segments through the non-common endpoints. Construct a parallelogram using the three endpoints of the segments and the intersection of the parallel lines. This construction is valid because the parallel line constructions guarantee that the opposite sides of this figure will be parallel. Notice that this construction has nothing to do with sides of equal length. The opposite sides of the parallelogram are congruent as a consequence of the parallel sides.

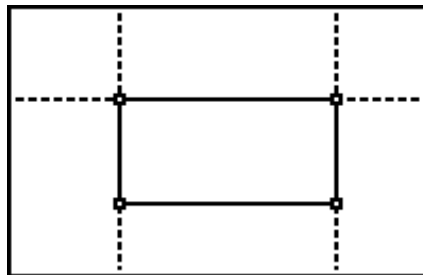


Rhombus: Construct a circle with center A and radius point B . Construct a second point on the circle (point D). Use the **Compass** tool to create a circle having the radius equal to \overline{AB} centered at points B and D (one at a time). The intersection of these two circles will be at point A and point C . Use the **Quadrilateral** tool to overlay a quadrilateral on top of the four



vertices. This construction is valid because the radii of congruent circles are congruent. Notice that this construction has nothing to do with parallel lines. The opposite sides of the rhombus are parallel as a consequence of the equality of the lengths of the sides.

Rectangle: Construct a segment. Construct lines perpendicular to the segment at both end points. Construct a third line perpendicular to either of the first two perpendicular lines. This third perpendicular line will also be perpendicular to the other perpendicular line, thus creating four right angles. Use the **Quadrilateral** tool to overlay a polygon that is guaranteed to be a rectangle. This construction is valid because three right angles have been constructed as specified in the minimal definition.



Square: Construct two circles such that the center of one is the radius point of the other. Construct a segment connecting the centers of the two circles and then construct lines perpendicular to this segment at each center (endpoint). Complete the square using the **Quadrilateral** tool to connect the centers of the circles and the intersection points of the circles and the perpendicular lines. This construction is valid because all the radii of congruent circles are congruent and the perpendicular constructions guarantee right angles.

