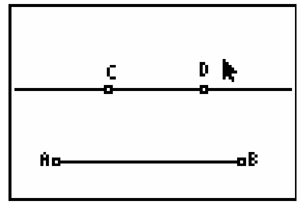
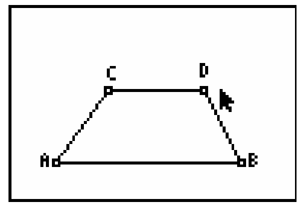
Cabri Jr. Activity 17 – Properties of Trapezoids and Isosceles Trapezoids

A trapezoid is a quadrilateral where one pair of sides is parallel while the other two sides are not. In an isosceles trapezoid the non-parallel sides are congruent. In this activity we will attempt to create an isosceles trapezoid from an ordinary trapezoid, then approach the problem in a different manner and finally, examine the properties of trapezoids.

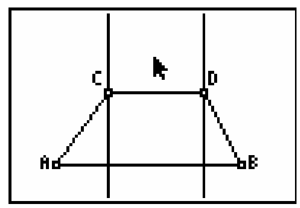
Let's start with a line segment AB and a point C above AB. Create a line through C that is parallel to AB. Construct a point on the new line and label it D.



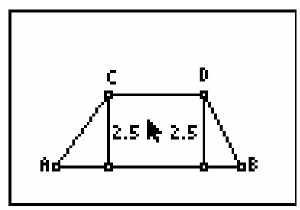
Hide the parallel line and complete the trapezoid. Measure the interior angles. Are the base angles at C and D congruent? Will they ever be? What about the base angles at A and D? Measure the lengths of the diagonals AD and BC. Will they ever be congruent?



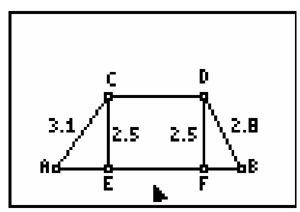
To verify that the lines are parallel, construct lines through C and D that are perpendicular to AB.



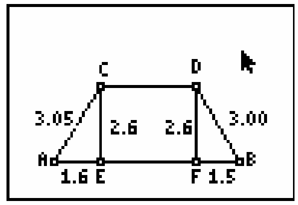
Construct the points of intersection of the new lines with AB. Construct lines segments to connect C and D to the line through AB and measure the lengths of these segments. Will these segments always be equal? Should they be? Why?



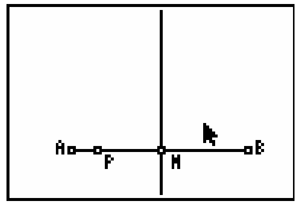
Label the new points on AB as E and F and measure the lenghts of AC and BD. Will AC ever be congruent to BD?



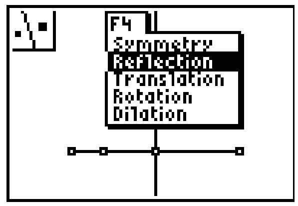
Try to drag point C or point D to make AC = BD. Due to the screen resolution, this can be very difficult. Construct line segments AE and BF. For an isosceles trapezoid, these segments should also be congruent. Can you explain why?



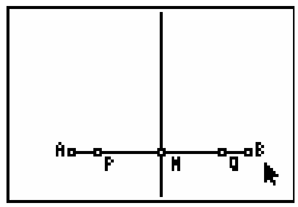
In order to construct an isosceles trapezoid, start with a line segment AB. Construct the midpoint, M, and another point, P, on AB. Construct a line through the M that is perpendicular to the AB.



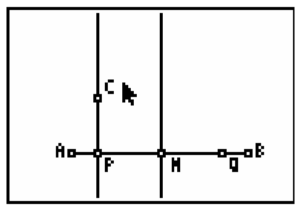
Press a and select the Reflection option. Click on the perpendicular line through M and then point P.



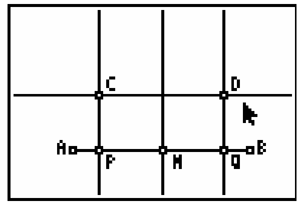
A new point will appear on the line segment on the right side. Label this point Q.



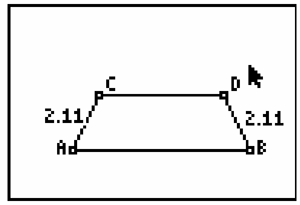
Construct perpendicular lines through P and Q. Construct point C on the perpendicular through P.



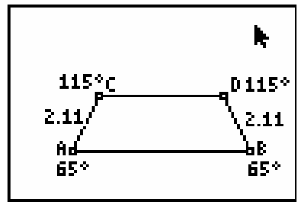
Construct a perpendicular to AB through point Q and a line through C that is parallel to AB. Construct point D at the intersection of these two lines.



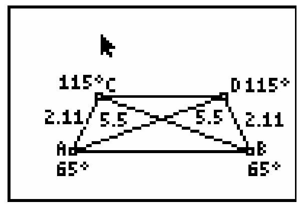
Hide the parallel and perpendicular lines and points M, P and Q. Complete the trapezoid and measure AC and BD. Can you explain why these line segments are congruent? In an isosceles trapezoid, the diagonals are congruent and the adjacent base angles are congruent.



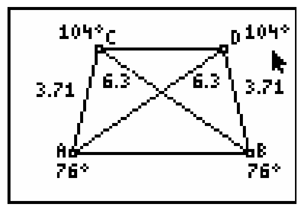
Measure the base angles – the interior angles at A, B, C and D. Which angles are congruent? Did you expect those angles to be congruent? Can you prove that they are?



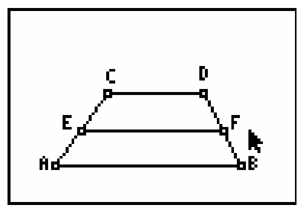
Construct and measure the lengths of the two diagonals AD and BC. Should they be congruent? Can you prove that they are?



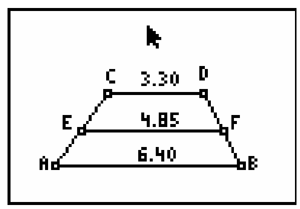
Drag point C and watch the angles and sides. Are all of the properties established above preserved?



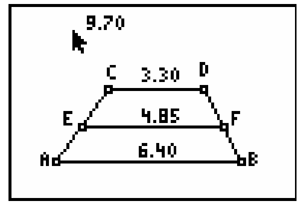
However, one property that is common to all trapezoids is that the line segment connecting the non-parallel sides is also parallel to these sides and its length is half the sum of the parallel sides. Construct a trapezoid ABCD. Construct the midpoints at E and F and construct the line segment EF.



Measure the lengths of CD, EF and AB. How could you prove that EF is parallel to CD and AB?



Use the Calculate tool to find the sum of the lengths of CD and AB.



Place the number "2" on the screen and divide the sum by 2 using the calculate tool. Will this result always equal the length of EF? Can you prove this result?