

Parallelograms - Discovering Their Properties

Geometry Major Topics: Parallelograms

NCTM Principles and Standards:
Content Standards

Geometry:

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them.

Establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others.

Apply transformations and use symmetry to analyze mathematical situations.

Objectives: This lesson has students discover properties of parallelograms. Using the CABRI Geometry II Application for the TI-89 calculator, students construct a figure and use the definition to discover the figure is a parallelogram. They will then discover properties of the parallelogram. This lesson can be used as a teacher directed activity or can be given to the students as a discovery activity. If the students are familiar with the CABRI Geometry II Application, this activity should take one 50 minute class period.

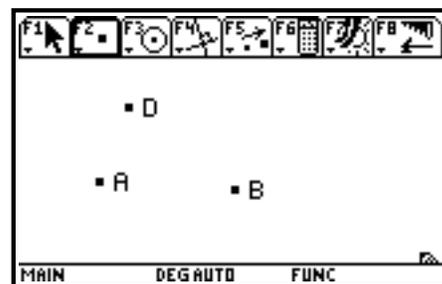
Materials: TI-89 Graphing Calculator, CABRI Geometry II Application

Prerequisites: Students should have a working knowledge of the CABRI Geometry II software, know the definitions of a parallelogram and a diagonal of a quadrilateral, and be familiar with the algebraic or slope definition of parallel.

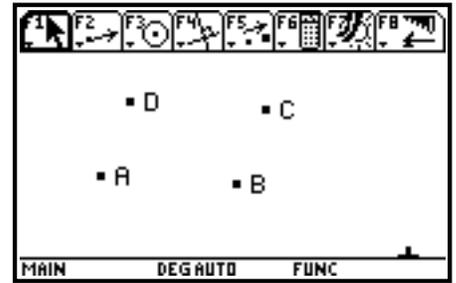
Procedure:

A. The Construction:

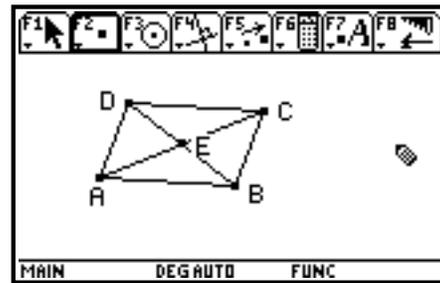
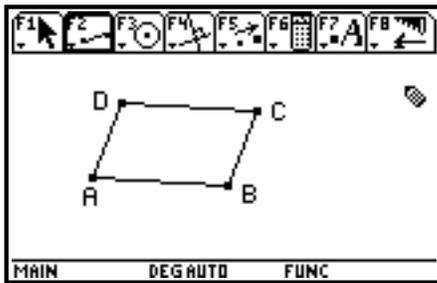
1. Open the CABRI Geometry II Application on the TI-89 by pressing the APPS button and choosing Cabri Geometry. Open a NEW file and choose an appropriate variable name, perhaps prlgram.
2. Press F2 and choose **1:Point**. Draw and label three noncollinear points A, B, and D, as shown in the figure. (Note: To label a point immediately, press the up arrow key on the TI-89 keyboard and then type the letter.)
3. Press F2 and choose **7:Vector**. Draw a vector from point A to point B.



4. Press F5 and choose **1:Translation**. Move the cursor to point D; when the message "translate this point", appears, press ENTER. This establishes the point as the object to be translated. Move the cursor to the vector; when the message "by this vector" appears, press ENTER. This translates point D in the direction of the vector by the magnitude of the vector. Label the new point, the fourth vertex of the figure, C.



5. Press F7 and choose **1:Hide/Show**. Hide the vector.
6. Press F2 and choose **5:Segment**. Draw segments AB, BC, CD, and AD. Press F2 and choose **5:Segment**. Draw segments DB and AC and label the point of intersection E. Your screens should be similar to the ones below.



7. Press F6 and choose **4:Slope**. Measure the slopes of AB, BC, CD, and AD and record below.

slope of AB=
slope of CD=

slope of BC=
slope of AD=

8. What type of quadrilateral is ABCD? Why? Make a conjecture concerning your observation. Drag point D to test that your conjecture holds for all cases.

Teacher Note: The students should discover the figure is a parallelogram by the definition. If both pairs of opposite sides of a quadrilateral are parallel, then the quadrilateral is a parallelogram. This is determined from the slopes as measured in step 7.

B. The Measurements:

1. Press F6 and choose **3:Angle**. Measure angle DEC and record below:

$m \angle DEC =$

2. Press F6 and choose **1:Distance and Length**. Measure DB and AC and record below:

DB = AC =

3. Press F6 and choose **1:Distance and Length**. Measure AE, CE, BE, and DE and record below:

AE = CE = BE = DE =

C. The Questions: As you answer each question, drag point D. Does the conjecture hold in all cases?

1. Are the diagonals perpendicular? Why? _____

2. Do the diagonals bisect each other? _____

3. Are the diagonals congruent? _____

4. Drag Point D. Do the diagonals bisect each other? _____

Teacher Notes: (answers to questions)

1. By the measurement in Part B 1, since the measure of $\angle DEC$ is not 90° , the diagonals are not perpendicular.

2. By the measurements in Part B 3, the diagonals do bisect each other.

3. By the measurements in Part B 2, the diagonals are not congruent.

4. The diagonals still bisect each other after point D is dragged.

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