

# Parallel or Perpendicular - What's Your Inclination?

**Geometry Major Topics:** Parallel and Perpendicular Lines

**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.

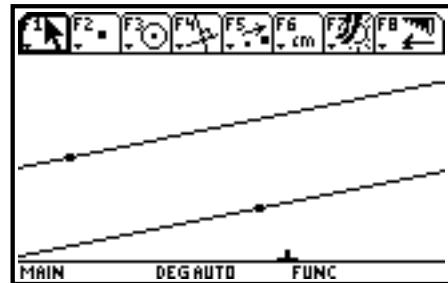
**Objectives:** This lesson has students discover the relationships between parallel and perpendicular lines and their slopes. After constructing these objects using the CABRI Geometry II Application for the TI-89 calculator, the slopes are measured. Dynamically manipulating the lines, the students discover relationships between the slopes and whether the lines are parallel, perpendicular, or neither. 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 and be familiar with the geometric properties of parallel and perpendicular lines.

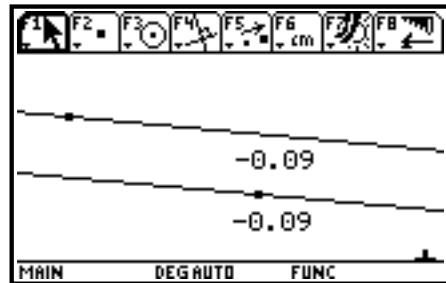
**Procedure:**

Activity 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 lines. Press F2 and choose **4:Line**. Construct two lines on the screen, being careful not to draw horizontal or vertical lines. Press F6 and choose **4:Slope**. Measure the slope of each line. Press F1 and choose **1:Pointer**. Drag one of the lines until the slopes are the same. Make a conjecture concerning your observation.

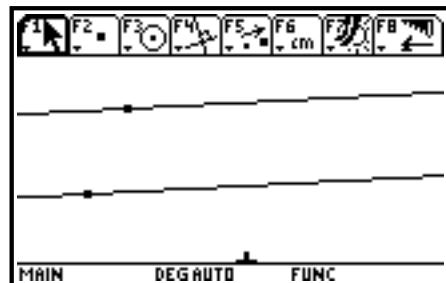


Drag each of the lines several more times, changing the slopes and then making the slopes the same. Does your conjecture hold in all cases?

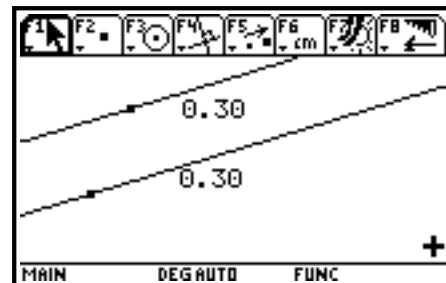
**Teacher Note:** The conjecture should be "if the slopes of two lines are the same, then the lines are parallel". The teacher can extend this activity and have students draw two lines that appear horizontal and two lines that appear vertical and recognize the slopes of these special cases.



Activity 2: Press F8 and choose **8:Clear All**. Press ENTER to clear the screen for the next construction. Press F2 and choose **4:Line**. Construct a line on the lower half of the screen, being careful not to draw a horizontal or vertical line. Press F2 and choose **1:Point**. Construct a point above the line. Press F4 and choose **2:Parallel Line**. Construct a line through the point parallel to the given line.

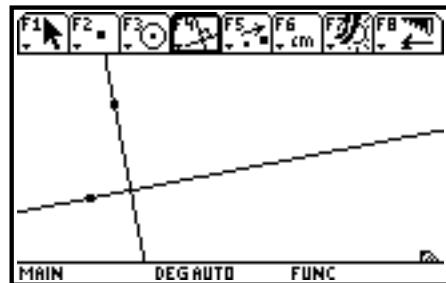


Press F6 and choose **4:Slope**. Measure the slope of each line. Make a conjecture concerning your observation. Drag the original line to change its slope. Perform this step several more times. Is your conjecture still true?

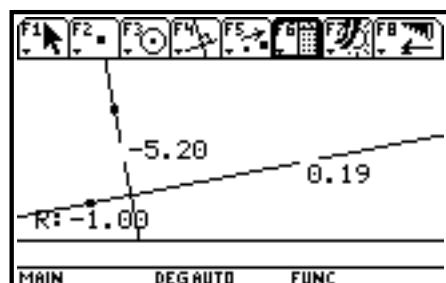


**Teacher Note:** The conjecture should be "if two lines are parallel, then the slopes of two lines are the same".

Activity 3: Press F8 and choose **8:Clear All**. Press ENTER to clear the screen for the next construction. Press F2 and choose **4:Line**. Construct a line on the lower half of the screen, being careful not to draw a horizontal or vertical line. Press F2 and choose **1:Point**. Construct a point above the line. Press F4 and choose **1:Perpendicular Line**. Construct a line through the point perpendicular to the given line.

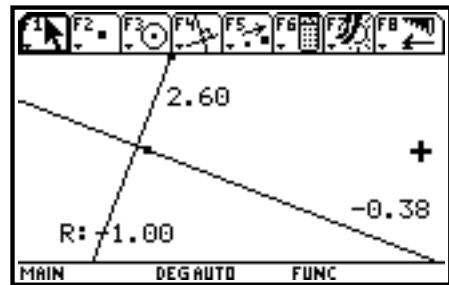


Press F6 and choose **4:Slope**. Measure the slope of each line. Press F6 and choose **6:Calculate**. Press the top arrow on the cursor pad to select the slope of the original line and press ENTER. This places the measurement on the entry line. Press the multiplication symbol on the TI-89. Press the top arrow on the cursor pad, select the slope of the perpendicular line, and press ENTER. With the cursor on the entry line, press ENTER. The product is displayed on the screen after the R. Make a conjecture concerning your observation.

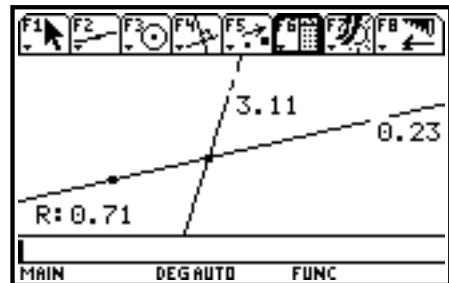


Press F1 and choose **1:Pointer**. Drag the original line to change its slope. Repeat this step several more times. Is your conjecture still true?

**Teacher Note:** The conjecture should be "if two lines are perpendicular, then the product of the slopes is negative one". Since the calculator cannot display the slopes as fractions, the teacher might want to ask the students about the relationship between the two numbers if their product is negative one, thus producing the conjecture "if two lines are perpendicular, then the slopes are opposite reciprocals of each other".

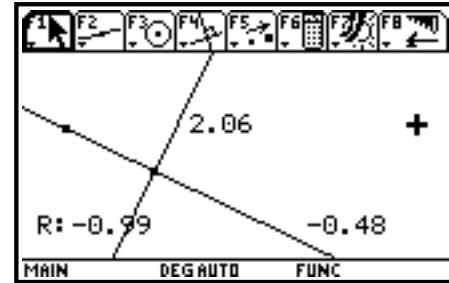


Activity 4: Press F8 and choose **8:Clear All**. Press ENTER to clear the screen for the next construction. Press F2 and choose **4:Line**. Construct two intersecting lines on the screen, being careful not to draw horizontal or vertical lines. Press F6 and choose **4:Slope**. Measure the slope of each line. Press F6 and choose **6:Calculate**. Using the technique in Activity 3, find the product of the slopes. What do you observe about the lines?



Press F1 and choose **1:Pointer**. Drag one of the lines to change its slope. What do you think the product of the slopes should be in order for the lines to be perpendicular? Test your conjecture by dragging the second line. Make a conjecture concerning the slopes of perpendicular lines.

**Teacher Note:** The students might have a difficult time trying to obtain a product of negative one; a product reasonably close to negative one should be acceptable. The conjecture should be "if the product of the slopes of two lines is negative one, then the lines are perpendicular".



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