In this investigation you'll learn how you can use slope to tell whether lines are parallel or perpendicular.

SKETCH AND INVESTIGATE

Choose **Preferences** from the Edit menu and go to the Units panel.

Select, in order, points *A*, *E*, and *C*; then, in the Measure menu, choose **Angle.**

While holding down the Shift key, choose **Hide Coordinate System** from the Graph menu.

Choose **Calculate** from the Number menu to open the Calculator. Click a measurement to enter it into a calculation.

- In Preferences, set Angle Precision to tenths and precision of Others to hundredths.
- 2. Construct \overrightarrow{AB} and \overrightarrow{CD} and their point of intersection, *E*.
- 3. Measure $\angle AEC$.
- 4. Measure the slopes of \overrightarrow{AB} and \overrightarrow{CD} .
- 5. Hide the coordinate system that appeared when measuring the slopes.
- 6. Drag point *A* and observe the slope measures.
- **Q1** Make the slopes as close to equal as you can. What do you observe about the measure of the angle between the lines?
- **Q2** If you get the slopes close enough to equal, the angle measure will actually disappear. Why do you think that happens? (*Hint:* The vertex of this angle is the point of intersection of the two lines.)
- **Q3** Write a conjecture about lines with equal slopes.
- 7. Calculate the product of the slopes of \overrightarrow{AB} and \overrightarrow{CD} .
- 8. Make sure that neither line is horizontal. Drag points to make m $\angle AEC$ as close to 90° as you can.
- **Q4** What is the product of the slopes of perpendicular lines?
- **Q5** Why is this product always negative?
- **Q6** The product of the slopes of two lines is undefined if one of the lines is vertical. Why?

EXPLORE MORE

9. In the same sketch, mesure the equations of the two lines. Where does the slope of a line appear in its equation?

 $m \angle AEC = 38.3^{\circ}$ $Slope \overleftrightarrow{AB} = 0.56$ $Slope \overleftrightarrow{CD} = -0.16$ A E CD



For GSP5

It may help to choose **Snap Points** from the Graph menu.

- 10. In a new sketch, show the coordinate grid. Scale the grid, if necessary, so that grid points are about 1/2 in. (or 1 cm) apart. Hide the axes. Draw a line and a point not on the line. Now construct a second point not on the line, located so that when you draw a second line through these points it will be parallel to the first line. Explain how you located the second point.
- 11. Confirm your parallel-line slope conjecture by constructing a line and a point not on the line. Through the point not on the line, construct a parallel line. Measure the slopes of the two lines. Drag different points and observe the slope measurements. Do a similar investigation for perpendicular lines. Explain what you did and what your investigatons demonstrate.