CABRI JR.: AN ALTERNATIVE TO GSP

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Many college students have minimal experience investigating, conjecturing, and validating geometric concepts, spending much of their time and energy memorizing static relationships and theorems. Yet, a small but growing number of students who now populate a college-level introductory geometry course have some experience with *The Geometer's Sketchpad (GSP)* software. An alternative to *GSP* is the *Cabri Jr.* application for the TI-83 Plus or TI-84. *Cabri Jr.* provides a dynamic learning environment that frees students from the confines of a computer lab, enables them to explore geometric concepts on their graphing calculator, and moves them from inactive to interactive learners. It is now possible to assess students' conceptual understanding based on what students have discovered or constructed. This paper provides a sampling of *Cabri Jr.* activities that have been used in an introductory geometry course for K-8 pre-service teachers.

EXTERIOR AND REMOTE INTERIOR ANGLES OF A TRIANGLE

To draw a triangle, open the Drawing Tools Menu (F2), highlight Triangle, and press ENTER. Move the cursor to the desired location for a vertex and press ENTER to anchor the first vertex of the triangle. Repeat this procedure for the second and third vertices. Label the vertices by opening the Display Tools Menu (F5), highlighting Alph-Num, and pressing ENTER. Move the cursor to a vertex, watching for the vertex point to blink when the cursor is close enough, and press ENTER to create a label for the point. Type the label (A) and press ENTER to complete the label. Repeat this process for the other two vertices (B and C). When finished, press CLEAR to exit the Alpha-Numeric Tool.
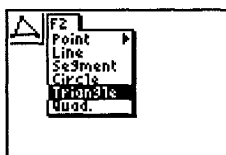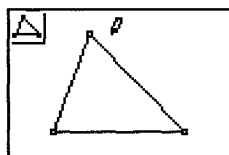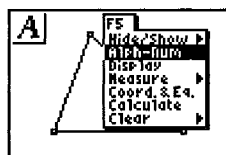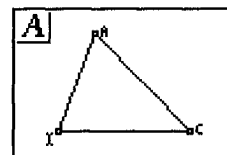

| Figure 1 | Figure 2 | Figure 3 | Figure 4 |

To measure the three angles of △ABC, open F5, highlight Measure, press the right arrow key to view the Measure menu, cursor down to Angle, and press ENTER. For the first angle select three points, making certain to select the vertex point of the angle second, by pressing ENTER each time the cursor causes each of the three points to blink. Move the measurement using the arrow keys if desired. Press CLEAR. Repeat this process for the other two angles. When finished, press CLEAR to exit the Measure Angle tool.
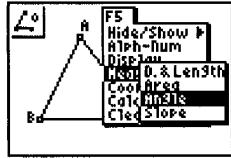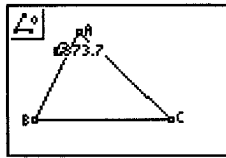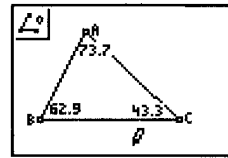
Figure 5 Figure 6 Figure 7

To calculate the sum of the alternate interior angles, open F5, highlight Calculate, and press ENTER. Move the cursor to the measure of ∠A, press ENTER, press + to indicate addition, move the cursor to the measure of ∠B, and press ENTER. Use the arrow keys to move the calculation to a blank area of the screen and press ENTER to anchor it. Move the cursor to the calculated sum, press + to indicate addition, move the cursor to the measure of ∠C, and press ENTER. Use the arrow keys to move the calculation to a blank area of the screen and press ENTER. Be aware that *Cabri Jr.* measures angles to two decimal places, but displays each measurement to only one decimal place. Thus, the displayed angle measurements sometimes appear inaccurate. Drag a vertex of one of the angles by moving the cursor to highlight the desired vertex, press ALPHA to grab it (a hand appears), and use the arrow keys to move the vertex around the screen as different types of triangles emerge, noting what happens to the angle measures and their sum.
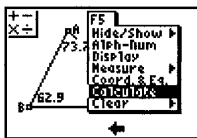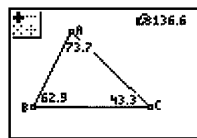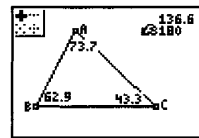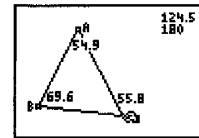

Figure 8 Figure 9 Figure 10 Figure 11

To construct an exterior angle at ∠C, open F2, highlight Line, and press ENTER. Move the cursor to vertex B, press ENTER, move the cursor to vertex C, and press ENTER. Construct and label a point D that lies on line BC and to the right of point C. Measure ∠ACD and move the measurement to the desired location. Drag a vertex of ΔABC and observe what happens to the interior and exterior angle measures and their sum.
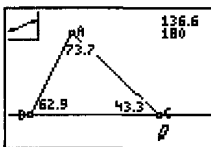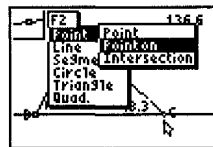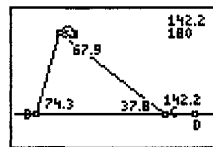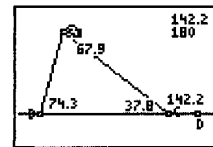

Figure 12 Figure 13 Figure 14 Figure 15

ANIMATION

<u>Central Angle of a Circle</u> - To create a circle, open F2, highlight Circle, and press ENTER. Move the cursor to the desired location for the center, press ENTER, press the right arrow key to increase the size of the circle, and press ENTER to draw the circle. Select Segment from the F2 menu and draw two radii. Press CLEAR, select F5, and highlight Alph-Num to label the center as O and the points A and B on the circle.
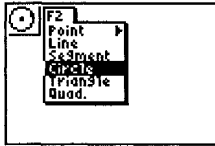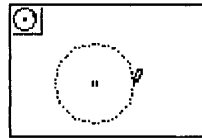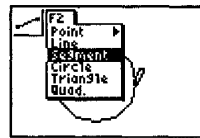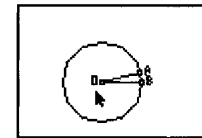
| Figure 16 | Figure 17 | Figure 18 | Figure 19 |

Measure ∠AOB, move the angle measurement using the arrow keys if desired, and press CLEAR. To animate point A, select F1, highlight Animate, and press ENTER. Move the cursor to point A and press ENTER to begin the animation. Press 2nd and ENTER to stop the animation. Notice that the central angle measurement is never greater than 180°.
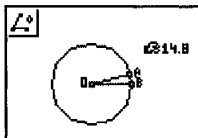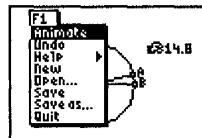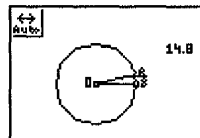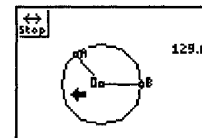

| Figure 20 | Figure 21 | Figure 22 | Figure 23 |

Areas of Triangles - To investigate the area of different types of triangles having equal bases and equal area, open F2 to draw a segment and label the endpoints E and F. Select F2, highlight Point, choose Point, and press ENTER. Use the arrow keys to position a point below segment EF, press ENTER, and label the point as B. To construct a line parallel to segment EF through point B, choose F3, highlight Parallel, and press ENTER. Move the cursor to point B and press ENTER. Move the cursor to segment EF and press ENTER. Select F2, highlight Triangle, and draw a triangle with one vertex at B, one vertex on segment EF between points E and F, and one vertex on the parallel line. Label the uppermost vertex as A and the remaining triangle vertex as C.
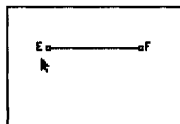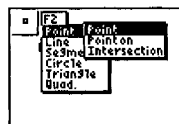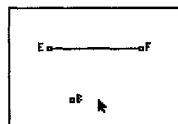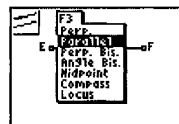

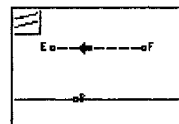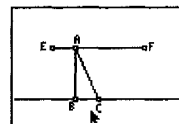| Figure 24 | Figure 25 | Figure 26 | Figure 27 | Figure 28 | Figure 29 |

To investigate the area of the triangle, open F5, highlight Measure, select Area, move the cursor to the triangle, and press ENTER. Move the angle measurement using the arrow keys if desired and press CLEAR. Measure the length of segment BC by using F5, highlighting D & Length, and pressing ENTER. Move the cursor to point B, press ENTER, move the cursor to point A, and press ENTER. To measure the distance between line BC and point A, choose F3 and highlight Perp. Move the cursor to point A, press ENTER, move the cursor to line BC, press ENTER, and press CLEAR.
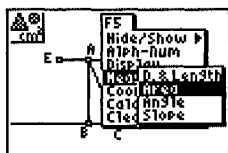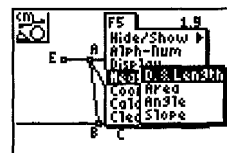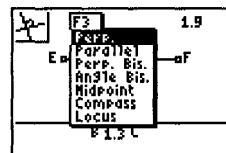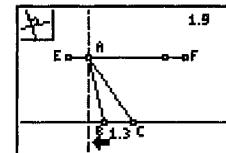

| Figure 30 | Figure 31 | Figure 32 | Figure 33 |

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To find the intersection of line BC and the line perpendicular to it, select F2, Point, Intersection and press ENTER. Move the cursor until both lines highlight and press ENTER. Label the intersection point as D. Determine the altitude of ∆ABC by measuring the distance between points A and D. Hide the perpendicular line by choosing F5, highlighting Hide/Show and Object, pressing ENTER, moving the cursor to highlight the perpendicular line, pressing ENTER, and pressing CLEAR.
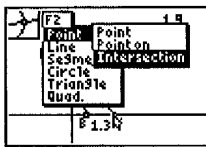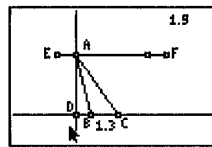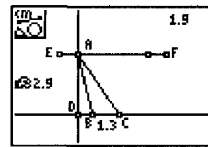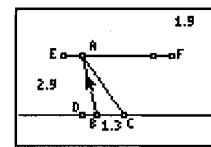
| Figure 34 | Figure 35 | Figure 36 | Figure 37 |

To animate point A, open F1, highlight Animate, and press ENTER. Move the cursor to point A and press ENTER to begin the animation. Observe the measurement values as the triangle changes from acute to right to obtuse. Press 2nd and ENTER to stop the animation. Press CLEAR to exit the animation. Increase the length of the triangle's base by dragging either vertex B or C and using the arrow keys. Repeat the animation of point A and observe the area, base, and altitude measurement values.
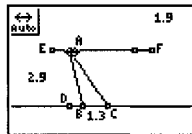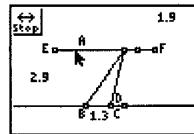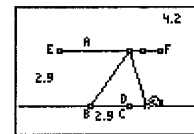
| Figure 38 | Figure 39 | Figure 40 |

EQUATIONS OF LINES

To investigate the coordinate geometry capabilities of *Cabri Jr.*, begin by opening F5, highlighting Hide/Show, choosing Axes, and pressing ENTER. Draw a line by selecting F2, Line, pressing ENTER, and constructing an arbitrary line that intersects the y-axis. Return to F5, select Coord & Eq, press ENTER, move the cursor to highlight and select the line and both points on the line, move the slope-intercept equation and the coordinates to a convenient location, and press CLEAR.
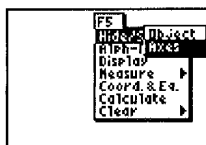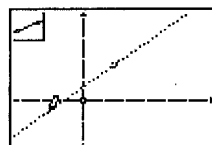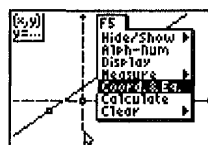
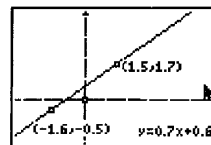| Figure 41 | Figure 42 | Figure 43 | Figure 44 |

To measure the slope of the line, select F5, Measure, Slope and press ENTER. Move the cursor to highlight the line, press ENTER, and move the measurement if desired. Drag either point on the line and observe how the line's slope changes. Notice the slope of a horizontal line and the value of the y-intercept.
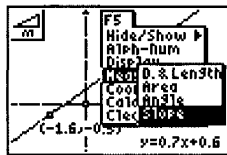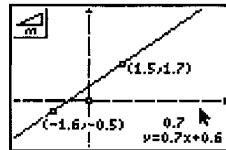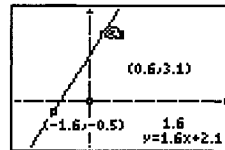
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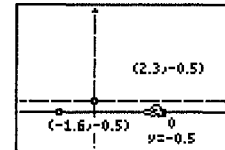| Figure 45	Figure 46	Figure 47	Figure 48

Drag the line until it is vertical and observe the calculated slope, the absence of a y-intercept value, and the appearance of an x-intercept value. Create a line with a negative slope by continuing to drag a point on the line. Drag the point closest to the y-axis until it lies on the y-axis. Observe the coordinates of the y-intercept and the slope-intercept equation as the point on the y-axis moves along the y-axis.
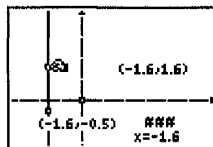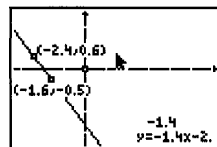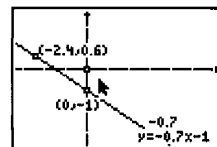
Figure 49	Figure 50	Figure 51	Figure 52

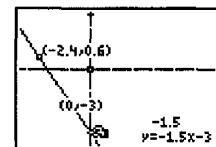## A TRIANGLE AREA PROBLEM

Construct ΔABC using F2, Triangle and label the vertices as points A, B, and C. To construct the midpoint of each side, select F3, highlight Midpoint, and press ENTER. Move the cursor to a triangle side and press ENTER. Repeat for a second side. Label the midpoints D and E. Construct segments DF and EF, where F is any point on segment BC. Label point F. Drag point F along segment BC and speculate whether or not there is a relationship between the areas of the three triangles and the area of the quadrilateral. Measure the area of ΔABC. Before computing the areas of the triangles and quadrilateral, use the Triangle tool and Quadrilateral tool to overlay ΔEBF, ΔDCG, and quadrilateral ADFE. Measure the areas of the three triangles and the quadrilateral. Make a conjecture regarding how the areas of the triangles relate to the area of the quadrilateral.
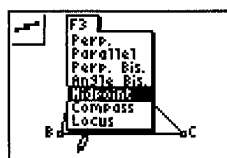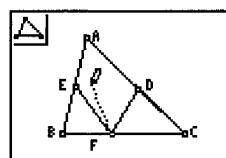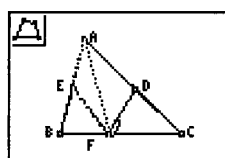
Figure 53	Figure 54	Figure 55	Figure 56

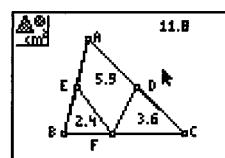## REFERENCES

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