Distances in the Coordinate Plane – ID: 8680
By Karen Campe

Time required
40 minutes

Activity Overview
In this activity, students will explore distances in the coordinate plane. After displaying the coordinates of a segment's endpoints, students will substitute these values into the distance formula and compare the results to the measured length of the segment. Then students will find the distance between the endpoints using the Pythagorean Theorem.

Concepts
- *Given the coordinates of the ends of a line segment, calculate its length.*

Teacher Preparation
This activity is designed to be used in a high school or middle school geometry classroom.

- *The Distance Formula for the distance between two points (x_1, y_1) and (x_2, y_2) is*
  $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

- *The Pythagorean Theorem for a right triangle with legs a and b and hypotenuse c is*
  $a^2 + b^2 = c^2$. *Solving for the hypotenuse, the equation becomes* $c = \sqrt{a^2 + b^2}$.

- *The screenshots on pages 2–4 demonstrate expected student results. Refer to the screenshots on page 5 for a preview of the student TI-Nspire document (.tns file).*

- ***To download the student and solution .tns files and student worksheet, go to education.ti.com/exchange and enter "8680" in the quick search box.***

Classroom Management
- *This activity is designed to be **student-centered** with the teacher acting as a facilitator while students work cooperatively. Use the following pages as a framework as to how the activity will progress.*

- *The student worksheet GeoAct30_Distance_worksheet_EN helps guide students through the activity and provides a place for students to record their answers and observations.*

- *The TI-Nspire solution document GeoAct30_Distance_Soln_EN.tns shows the result of working through the activity (segments constructed and expressions calculated).*

- *Depending on student skill level, you may wish to use points with integer coordinates, or only positive values.*

TI-Nspire™ Applications
Graphs & Geometry, Notes
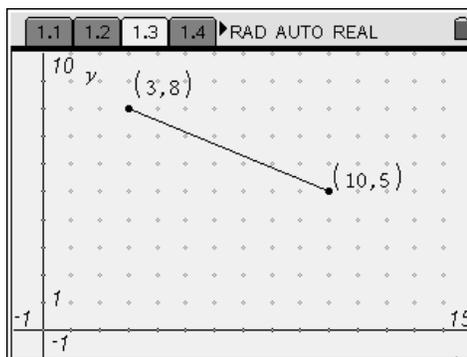
Problem 1 – The Distance Formula

Have students open the student TI-Nspire document and read the directions on page 1.2.

On page 1.3, students will construct a segment in the first quadrant. Using the **Point On** tool from the Points & Lines menu, students should plot two points directly on grid points. Then, they should connect the points using the **Segment** tool, also from the Points & Lines menu.
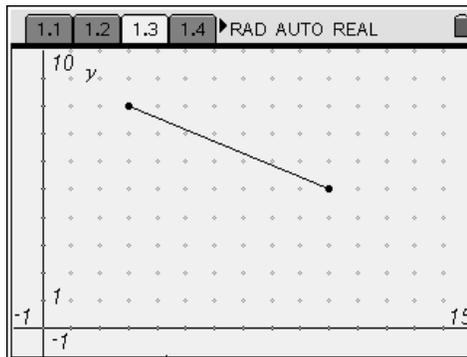
Direct students to display the coordinates of the endpoints of the segment using the **Coordinates and Equations** tool from the Actions menu.

Note: Press 🔘 (or ⏎) once to select the point whose coordinates you wish to show, and then press 🔘 (or ⏎) again to anchor the measurement to the screen.

Next, students should measure the length of the segment using the **Length** tool (**MENU > Measurement > Length**).

They can now drag the endpoints and observe that the segment length changes updates accordingly.
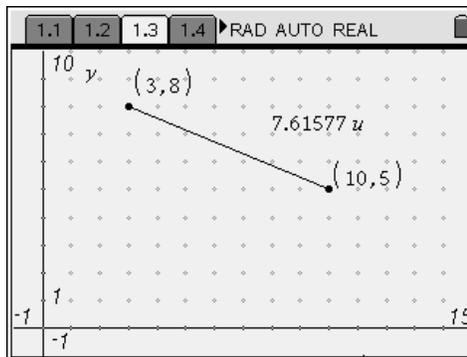
To use the Distance Formula to calculate the distance between the endpoints, have students select **MENU > Actions > Text** and enter the expression $\sqrt{(x2-x1)^2+(y2-y1)^2}$ in a text box.

Note: Press ⏎(tab) to advance to the next part of the text template after the exponent.
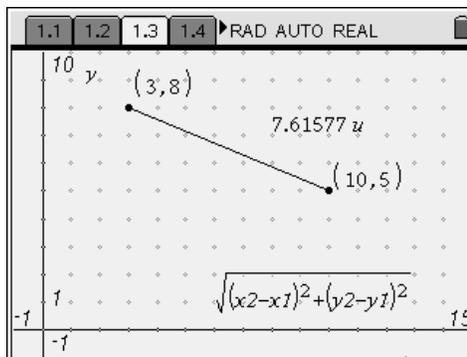
Then select **MENU > Actions > Calculate**, click on the expression, and click on the values of the coordinates for the endpoints for *x2*, *x1*, *y2* and *y1*. Caution students to select the coordinates in the proper order in which they are prompted!

Now, students can drag the segment endpoints and observe the calculation results as they update.

Discuss how these calculation results relate to the measured length of the segment.
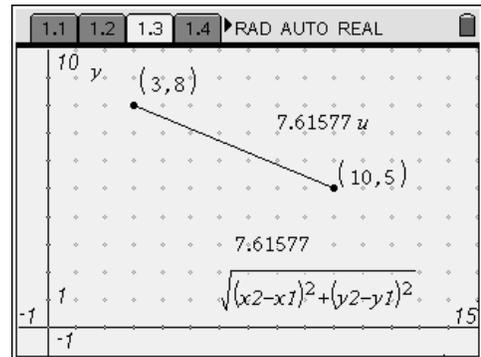
Problem 2 – The Distance Formula and the Pythagorean Theorem

Direct students to advance to page 2.1 and read the directions.

To create page 2.2, students should create a copy of page 1.3. Press (ctrl) + ▲ to go to **Page Sorter View**, then highlight page 1.3. Press (ctrl) + (C) to copy the page. Highlight page 2.1, then press (ctrl) + (V) to paste the copy as page 2.2.
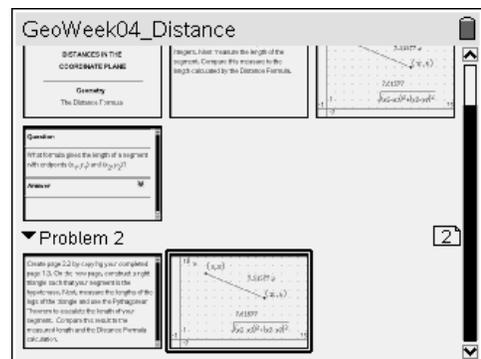
The following steps will help students construct a right triangle such that the segment they drew is the hypotenuse of the right triangle.

Select the **Perpendicular** tool from the Construction menu. Construct a line through the upper segment endpoint perpendicular to the *x*-axis. Construct a second line through the lower segment endpoint perpendicular to the *y*-axis.

Have students find the intersection of the perpendicular lines using **MENU > Points & Lines > Intersection Point(s)**.

Tell students to hide the perpendicular lines with the **Hide/Show** tool from the Actions menu. They should *not* hide the intersection point.

They should then construct segments for the legs of the right triangle using the **Segment** tool.
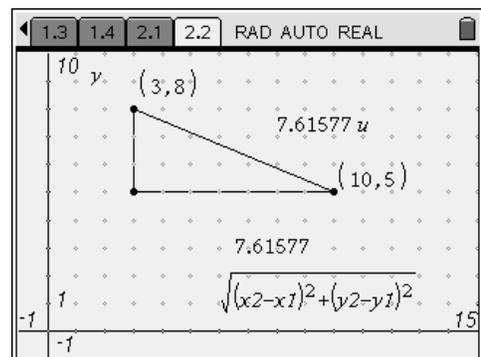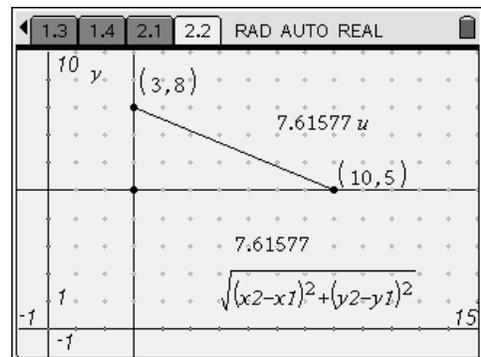
Next, have students find the length of each side of the triangle.

Discuss the lengths of the three sides of the triangle and decide which is longest.
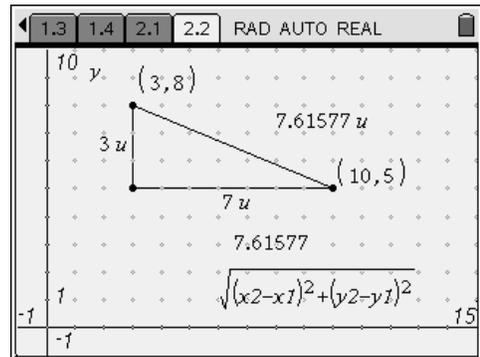
Use the **Text** tool to enter the expression $\sqrt{a^2 + b^2}$ in a text box.

Use the **Calculate** tool to evaluate the expression with the lengths of the legs as the values of *a* and *b*.
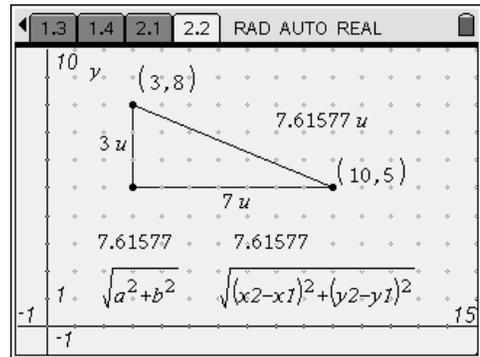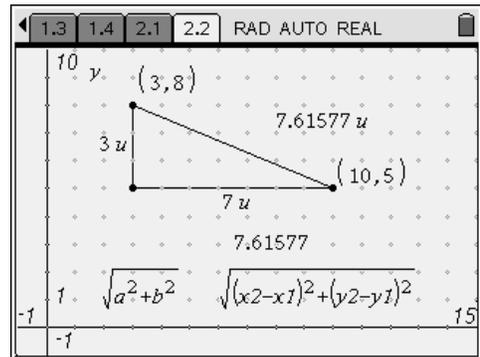
Students should drag the endpoints of the segment and observe the relationships among the three values:

- Measured length
- Calculated length (Distance Formula)
- Calculated Pythagorean distance

Discuss the connections between the Distance Formula and the Pythagorean Theorem.

Challenge students to explain how $\sqrt{a^2 + b^2}$ is derived from the Pythagorean Theorem.

Distances in the Coordinate Plane – ID: 8680

(Student)TI-Nspire File: *GeoAct30_Distance_EN.tns*

| 1.1 | 1.2 | 1.3 | 1.4 | ▶RAD AUTO REAL |

**DISTANCES IN THE
COORDINATE PLANE**

Geometry
The Distance Formula

| 1.1 | 1.2 | 1.3 | 1.4 | ▶RAD AUTO REAL |

On the next page, draw a line segment such that the coordinates of the endpoints are integers. Next measure the length of the segment. Compare this measure to the length calculated by the Distance Formula.

| 1.1 | 1.2 | 1.3 | 1.4 | ▶RAD AUTO REAL |

10 *y*

1

-1   15

-1

| 1.1 | 1.2 | 1.3 | 1.4 | ▶RAD AUTO REAL |

Question

What formula gives the length of a segment with endpoints (x_1, y_1) and (x_2, y_2)?

Answer   ⤵

| 1.2 | 1.3 | 1.4 | 2.1 | RAD AUTO REAL |

Create page 2.2 by copying your completed page 1.3. On the new page, construct a right triangle such that your segment is the hypotenuse. Next, measure the lengths of the legs of the triangle and use the Pythagorean Theorem to calculate the length of your segment. Compare this result to the measured length and the Distance Formula calculation.