



Cartesian Explorations

Topic Areas

- Cartesian Coordinates
- The xy-Plane
- Quadrants
- Patterns in the Plane

Objectives

- To introduce the Cartesian plane and the Cartesian coordinate system
- To use social play to build basic visualization and graphical representation skills
- To lay the foundation for investigating patterns of data represented as plots in the xy-plane

Introduction


In this activity sequence, students control points in the xy-plane. Exploring this space freely and responding to prompts, the students will develop understanding and intuition that will guide their use of graphing in Algebra throughout the year.

Prerequisites and Materials

Prerequisites: Fundamental arithmetic and number skills

Materials: The Activity Settings file, `CartesianExplorations.act` located on the CD.

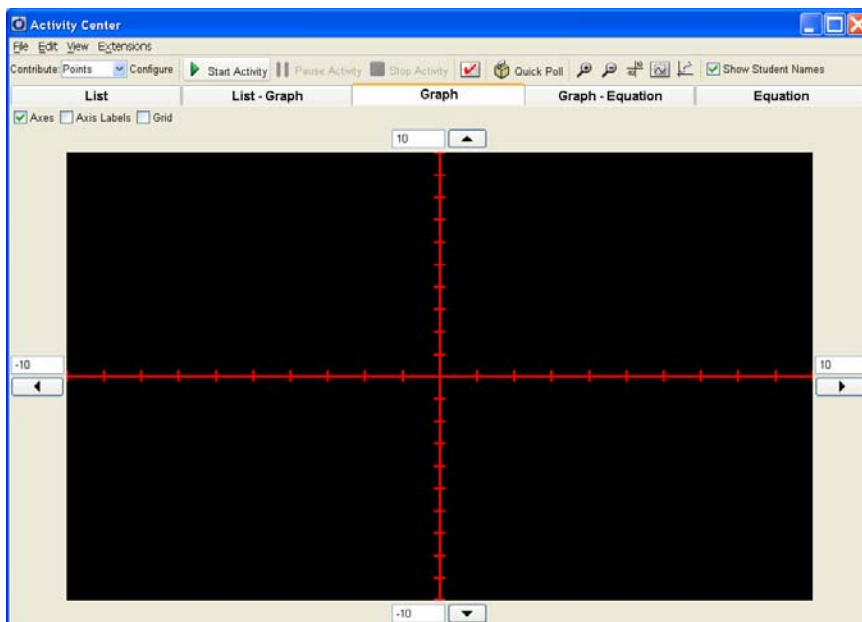
Setting Up the Activity

From the TI-Navigator™ teacher computer home screen, open the Activity Center, . Then choose **File>Load>Load Activity Settings** to load the activity settings file, `CartesianExplorations.act`.


If you would like to see the settings that are contained in this file, simply click the **Configure** button.

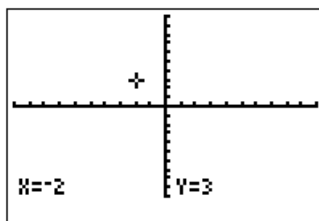
At the beginning of the activity, you should be on the **Graph** tab within the Activity Center.

Prepare your students for the activity by explaining that they will have control over a point in the two-dimensional Cartesian space, projecting the **Graph** tab of the Activity Center for public discussion.




Running the Activity

Press the **Start Activity** button, . Ask your students to log in on their calculators and go to the Activity Center. After the system configures their calculators for the activity they will be able to move their points around in the Cartesian plane.



The students begin at the origin, (0, 0). As they begin to explore, you will see their cursors fan out over the plane. Ask your students to compare the display on their calculators with the public display in the activity center and see if they can identify which point is theirs.

After giving them some time to work this out, you can provide an occasion for discussion by choosing **View>Individualize Student Cursors**. This will replace the generic cursors with icons that are unique for each student. If you like, you may also choose to pause the activity, , and ask students to volunteer to identify which point is theirs. You can let them check their answers by selecting the **Show Student Names** checkbox on the Activity Center toolbar. If you do this, then when you put your mouse over a cursor, you will see the coordinates of the cursor and the Display Name of the student who has contributed it.

Once your students are comfortable with the relationship between their calculator screens and the public space of the Activity Center, you can resume the activity, **II**, and allow them to continue exploring. If you have checked Show Student Names, we suggest that you uncheck it at this time, allowing the students to explore anonymously.

In this activity's settings your students have a Step Size of 1. That is, their cursors move one unit every time they press an arrow key.

Students should be permitted to move about in the space for a minute or two further without guidance. When they appear to be getting comfortable with controlling their point, however, draw their attention to the coordinate indicators at the bottoms of their screens. At this point, you may also wish to remove the **Individualize Student Cursors** function.

Ask your students to notice how the buttons that they are pressing are affecting the x- and y-values that they see at the bottom of their screens. Pause the activity, **II**, and ask them to put their observations into words, perhaps writing them down in paragraph form and/or working in pairs to formulate their descriptions.


Common Error: Students whose x-coordinates are negative may say that their coordinates are getting smaller, mistaking a change in magnitude for a change in value.

Now resume the activity, **II**, and ask the class what is the effect on the coordinates of pressing the right-arrow-key. When there is consensus, ask all the students to press the right-cursor button repeatedly and look at the public display. (If you like, you can ask them to move on your mark, to increase the regularity of the movement.) What does the overall class formation look like?

Next, ask them how to make their x-values get smaller. When they agree, again have the students move in unison.

Do the same work with y-values and the up and down arrow keys.

Summarize, consolidating the students' understanding that movement to the right corresponds to increasing x-coordinates; movement to the left corresponds to decreasing x-coordinates. Movement upward corresponds to increasing y-coordinates; movement downward corresponds to decreasing y-coordinates.

Consider checking for understanding with a Quick Poll, . For example, you could return to **Individualize Student Cursors** and ask them to consider inequality statements relating two points. For example, "True or False: The x-coordinate of the Yellow Circle is greater than the x-coordinate of the Blue Hourglass."

Pause the activity, **II**. Tell students that you would like them to move to a place where their x-values and y-values are both positive (if they are not already in such a place). Ask them to notice where they are on the screen when their values change sign. Resume the activity, **II**, and watch as they move to the first quadrant.


Roots of Words:

Consider explaining the meaning of the word "quadrant" by reference to its Latin root, *quad* (meaning "four"). Your students may know other words with this root (quadrilateral, quadrangle, or quadruped).

Pause the activity, **||**, and discuss the change of sign, identifying the axes as boundary lines of interest. Lead the students to notice that the Cartesian plane is divided into four regions by the axes, and introduce the terminology of quadrants. Identify the convention of naming quadrants (I, II, III, IV).

Tell students that they are next going to move using ONLY the left/right OR up/down arrow keys. If their x-value is greater than their y-value, they should change their y-value until it is a negative number. If their y-value is greater than their x-value, they should change their x-value until it is a negative number. Consider having the students confer with a partner about which coordinate they are going to change.

Resume the activity, **||**, and tell the students to begin moving. When they have finished moving, pause the activity, **||**, and discuss the pattern that has resulted – the students are in Quadrants II and IV. In these quadrants, the signs of the coordinates are different.

Consider a Quick Poll  on what the signs of the x- and y-coordinates will be in Quadrant III. You could use a multiple choice poll, writing the following options on the board:

- A) x positive, y positive
- B) x positive, y negative
- C) x negative, y positive
- D) x negative, y negative

If there is not consensus or complete understanding in the class, have students of different opinions discuss their reasoning.

Tell the students that they will be moving into Quadrant III to test their hypotheses, but that they should change one coordinate -- either their x- or their y-coordinate. Ask students from each group (the ones in Quadrant II and the ones in Quadrant IV, to discuss what coordinate will change and what coordinate will remain the same).

Resume the activity, **||**, and let the students test their hypotheses. Pause the activity, **||**.

Possible Stopping Point

In the remaining steps of this lesson, you can lead your students to see the significance of horizontal and vertical line-patterns in the plane. If this is not an appropriate direction for your class, however, you could stop here.

Ask for a volunteer among the group of students who moved only horizontally. Ask them to describe what happened to their coordinates – what changed and what remained the same. Work toward the observation that while their x-value changed from positive to zero to negative, their y-value remained constant (at the number it was before moving).

Now, ask the student to tell the class what that y-value was. Tell the class that you'd like only the other "horizontal movers" to move, and that you would like them to move to make their y-value the same as the volunteer's.

Resume the activity, **II**. When they have completed the task, ask them to spread out, keeping the y-value the same. Pause the activity, **II**, and have them notice that they have formed a pattern – a line!

If you like, draw the line by switching momentarily to the **Graph-Equation** tab and entering the equation. All of the points on this line will have the same y-coordinate.

Now, for the "vertical movers:" ask a student who moved vertically to describe her experience – what changed; what remained the same. Work toward the explanation that while the y-value changed from positive to zero to negative, the x-value remained constant (at the number it was before moving).

Now, ask the student to tell the class what that x-value was. Tell the class that you'd like only the other "vertical movers" to move, and that you would like them to make their x-value the same as the volunteer's. Resume the activity, **II**. When they have completed the task, ask them to spread out vertically, too, keeping their x-value the same. Pause the activity, **II**. Notice that they have formed another pattern – another line, but this time, vertical!

You can draw this vertical line by switching back to the **Graph-Equation** tab, choosing **View>Show X= Entry**, and typing in the equation.

Ask if there is a point that is part of both patterns. If there is a student at this intersection point, ask him what his coordinates are. If not, ask the class to guess what the coordinates of this point would be.

Resume the activity, **II**, and tell the students that they should move to that intersection point and check the coordinates. Watch the class's points converge on the intersection and overlap.

Stop the Activity, **■**.