



About the Lesson

In this activity, students will explore midpoints in the coordinate plane. Beginning with horizontal or vertical segments, students will show the coordinates of the endpoints and make a conjecture about the coordinates of the midpoint. This conclusion is extended to other segments in the coordinate plane.

As a result, students will:

- Write the coordinates of the midpoint of a line segment when given the coordinates of its ends.

Vocabulary

- midpoint

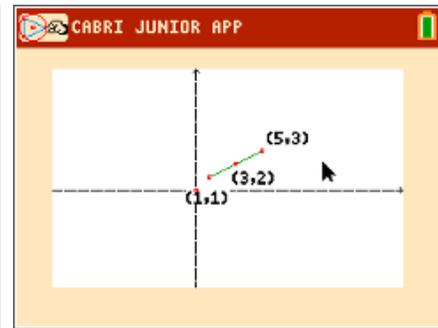
Teacher Preparation and Notes

- This activity is designed to be used in a high school or middle school geometry classroom.
- This activity is designed to be used with the Cabri Jr. app on the TI-84 Plus family of graphing calculators.
- The Coordinate Midpoint formula for the midpoint of (x_1, y_1) and (x_2, y_2) is $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$. This can also be expressed as “The coordinates of the midpoint of a line segment are the averages of the coordinates of the endpoints.”
- Depending on student skill level, you may wish to use points with integer coordinates, or only positive values.
- **Note:** The coordinates can display 0, 1, or 2 decimal digits. If 0 digits are displayed, the value shown will round from the actual value. To ensure that a point is actually at an integer value rather than a rounded decimal value, do the following:
 - Move the cursor over the coordinate value so it is highlighted.
 - Press $\boxed{+}$ to display additional decimal digits or $\boxed{-}$ to hide digits.

Activity Materials

- Compatible TI Technologies:
 - TI-84 Plus*
 - TI-84 Plus Silver Edition*
 - TI-84 Plus C Silver Edition
 - TI-84 Plus CE

* with the latest operating system (2.55MP) featuring MathPrint™ functionality.



Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

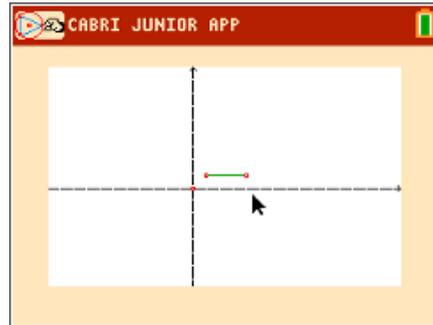
Lesson Files:

- Midpoints_In_Coordinate_Plane_Student.pdf
- Midpoints_In_Coordinate_Plane_Student.doc

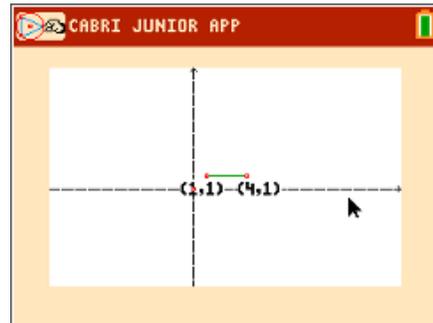


Problem 1 – Midpoints of Horizontal or Vertical Segments

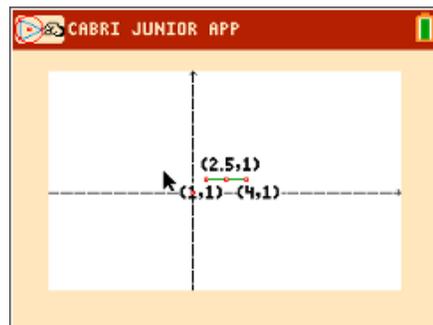
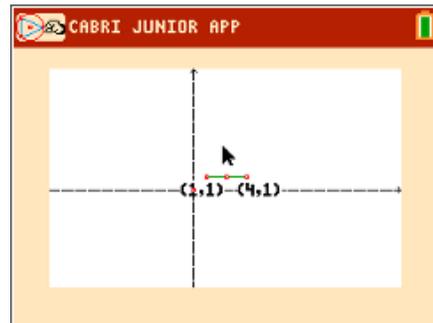
Students should open a new Cabri Jr. file. If the axes are not currently showing, they should select **Hide/Show > Axes**. They will construct a horizontal segment in the first quadrant using the Segment tool.



Students will select **Coord. & Eq.** and show the coordinates for the endpoints of the segment. If the coordinates of the endpoints are not integers, they need to use the **Hand** tool to drag the endpoints until the coordinates are integers. To activate the **Hand** tool, have students move the cursor over top an endpoint, press **[alpha]** and then use the arrow keys to move it to the desired location. They can press **[clear]** to release the endpoint.

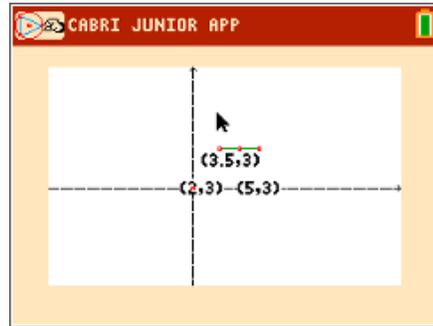


Students should now make a prediction about the coordinates for the midpoint of the segment. To check their predictions, students will select **Midpoint**, construct the midpoint of the segment, and then show its coordinates.

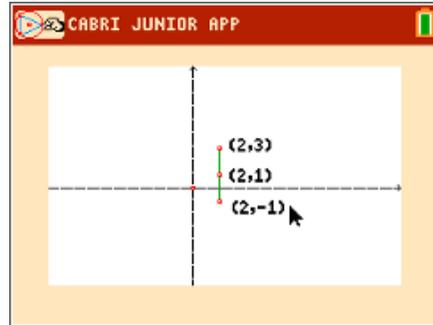




Before moving on, students need to hide the coordinates of the midpoint with the **Hide/Show > Object** tool. They should use the **Hand** tool to drag the segment to another location. (Hover the cursor over the segment and press **[alpha]** to grab it.) If you drag the entire segment, it will remain horizontal. Students can make a prediction about the new coordinates of the midpoint and check their prediction by showing the coordinates of the midpoint.



Repeat this exploration with a new segment. Use a vertical segment. If desired, have students explore midpoints of segments whose endpoints do not have integer coordinates, or are not in Quadrant 1.



1. List the coordinates for your horizontal and vertical segments.

Sample Answers:

Endpoints		Predicted Midpoint
(1, 1)	and (4, 1)	(2.5, 1)
(2, 3)	and (2, -1)	(2, 1)

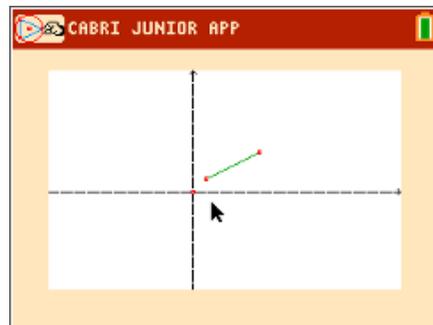
2. Describe how you can predict the coordinates of the midpoint of a horizontal or vertical segment.

Sample Answer: find the average of the x-coordinates and the average of the y-coordinates

Problem 2 – Midpoints of Diagonal Segments

Instruct students to open a new Cabri Jr. file. If needed, select **Hide/Show > Axes** to show the coordinate axes.

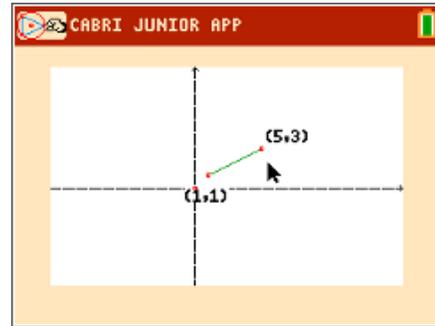
They should begin by using the **Segment** tool to construct a diagonal segment in the first quadrant.





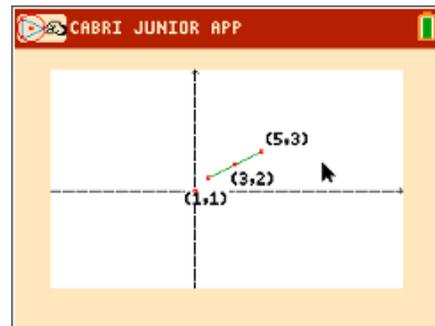
Students need to select **Coord. & Eq.** and show the coordinates for the endpoints of the segment.

If the coordinates of the endpoints are not integers, they should use the **Hand** tool to drag the endpoints to make the coordinates integers.



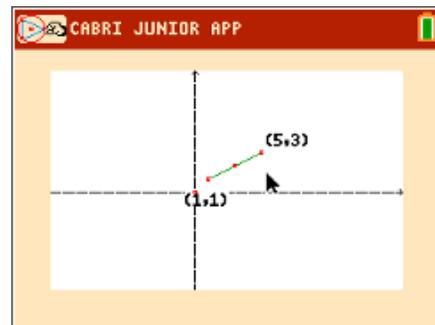
Students should now make a prediction about the coordinates for the midpoint of the segment.

To check their predictions, students will construct the midpoint of the segment and show the coordinates of the midpoint.



Students should now hide the coordinates of the midpoint with the **Hide/Show > Object** tool. Using the **Hand Tool**, students should drag the segment to another location. If the entire segment is selected, it will keep the same diagonal slant.

Students will make a prediction about the new coordinates of the midpoint and check their prediction by showing the coordinates of the midpoint.



Repeat this exploration with a new segment. If desired, direct students to again consider segments whose endpoints do not have integer coordinates or are not in Quadrant 1.

In pairs, students should discuss the following topic:

Describe in words how to find the coordinates of the midpoint of a segment if you know the coordinates of the endpoints. Try to write a formula or a rule for midpoints.



3. List the coordinates for your diagonal segments.

Sample Answers:

Endpoints		Predicted Midpoint	
(1, 1)	and	(5, 3)	(3, 2)
(1, 8)	and	(8, 9)	(4.5, 8.5)

4. Describe how you can predict the coordinates of the midpoint of a diagonal segment.

Sample Answer: find the average of the x-coordinates and the average of the y-coordinates

Exercises

Answers:

5. What formula gives the midpoint of the segment with endpoints (x_1, y_1) and (x_2, y_2) ?

Answer: the midpoint of (x_1, y_1) and (x_2, y_2) is $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Determine the midpoint of a segment with the following endpoints:

6. (3, 10) and (5, 10) **Answer:** (4, 10)
7. (1, 8) and (8, 9) **Answer:** (4.5, 8.5)
8. (7, 2) and (4, 4) **Answer:** (5.5, 3)
9. (-2, 3) and (5, -7) **Answer:** (1.5, -2)
10. (1.8, 4.9) and (7.2, 2.7) **Answer:** (4.5, 3.8)
11. (-3.3, 5.5) and (-5.5, 3.3) **Answer:** (-4.4, 4.4)

Given an endpoint and midpoint of a segment, find the other endpoint:

12. Endpoint (3, 1) Midpoint (3, 4) **Answer:** (3, 7)
13. Endpoint (2, 5) Midpoint (5, 6) **Answer:** (8, 7)
14. Endpoint (-4, 3) Midpoint (1, 0) **Answer:** (6, -3)