Math Objectives

- Students will describe different methods used to construct a perpendicular bisector and describe the classical construction of a perpendicular bisector.
- Students will use appropriate tools strategically (CCSS Mathematical Practice).

Vocabulary

- perpendicular
- bisector
- compass

About the Lesson

- The time varies for the activity depending on whether the .tns file is given or created by the students. It is strongly suggested that the students do create the document.
- This activity is designed to be student-centered, with the teacher acting as a facilitator while students work cooperatively. The student worksheet is intended to guide students through the activity and provide a place to record their answers.
- This activity assumes students have created their own constructions. You may want to review each method of construction before students begin the worksheet.
- If you are planning for students to create the file, take time to follow the directions prior to facilitating the process with students. Or send the file: *Creating_Perpendicular_Bisectors.tns* to student handheld devices.

TI-Nspire™ Navigator™ System

- Use Screen Capture to observe students' work as they proceed through the activity.
- Use Live Presenter to have students illustrates how they did a particular method.

TI-Nspire™ Technology Skills:
- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tips:
- Make sure the font size on your TI-Nspire handheld is set to Medium.
- You can hide the function entry line by pressing ⌈ctrl⌉ ⌈G⌉.

Lesson Materials:
Create Instructions
Creating_Perpendicular_ Bisectors_Create.pdf

Student Activity
Creating_Perpendicular_ Bisectors_Student.pdf
Creating_Perpendicular_ Bisectors_Student.doc

TI-Nspire document
Creating_Perpendicular_ Bisectors.tns

Visit www.mathnspired.com for lesson updates and tech tip videos.

Discussion Points and Possible Answers

> **Tech Tip:** If students experience difficulty dragging a point, check to make sure that they have moved the arrow until it becomes a hand (✋). Press `ctrl` 🖐 to grab the point and close the hand (✊).

1. Consider methods 1–5. Which of the methods allows you to change the length of the bisected segment so that it remains bisected by the perpendicular?

   Answer: all of the methods

   > **Teacher Tip:** If the students do not say all the methods as the answer, they may have made a mistake in the construction.

   TI-Nspire Navigator Opportunity: *Screen Capture*
   See Note 1 at the end of this lesson.

2. Classical constructions allow the use of only a straight edge and compass. Explain why each method is or is not considered a classical construction.

   Answer: Only method 1 is a classical construction.

   Method 2 requires the use of a ruler, not a straight edge.

   Method 3 uses the perpendicular tool.

   Method 4 requires the use of a ruler, not a straight edge.

   Method 5 does not use a compass at all and uses the perpendicular bisector tool.
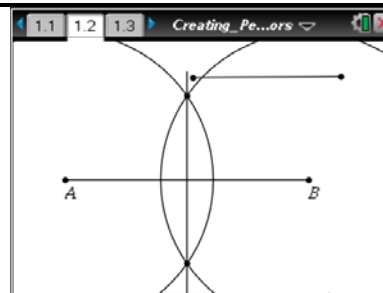
   TI-Nspire Navigator Opportunity: *Live Presenter*
   See Note 2 at the end of this lesson.

Move to page 1.2.

3. a. Change the length of the segment in the upper part of the screen by grabbing one of the endpoints. What do you observe?

   **Answer:** The perpendicular bisector stays the same or disappears**.**

b. In a classical construction of a perpendicular bisector, you are instructed to open your compass to a length that is more than half the given segment. Explain why this instruction is necessary.

Answer: If it is not opened more than half the given segment, the circles will not intersect to form the two points needed to draw the perpendicular bisector.

Move to page 1.3.

4. a. Double-click the text box that contains the number. Type in a different number. Press [enter]. Repeat this process several times. Describe what happens.
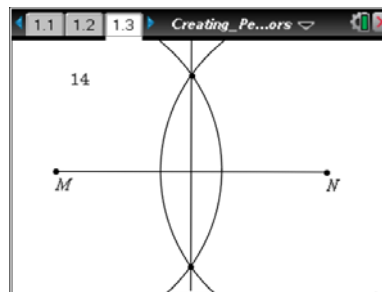
Answer: The radii of the circles change.

b. Estimate the length of the bisected segment.

Answer: The answers may vary, but they should be within a reasonable range using the scale in the top right corner of the screen. (To view the scale, press **Menu > View > Show Scale.**)

c. Choose a radius that is bigger than the length of the segments. What happens? (Note: You may have to grab the screen in a white space and use the NavPad to see what is going on above and below your handheld screen.)

Answer: The perpendicular bisector is still there, although the circles do not intersect the segment at all. The circles intersect each other farther away from the segment as the radius increases.

5. What is the difference between method 3 and method 5?

Answer: Method 3 uses the perpendicular tool to draw a line through the intersection points of the circles drawn. Method 5 does not use any visible circles; it uses the perpendicular bisector tool built in the technology.

6. If the intersection points of the two circles are labeled *D* and *E*, what kind of triangles are △*MDN* and △*MEN*? Explain how you know.

Answer: The triangles are isosceles triangles because the radii of the circles are equal by the way they were constructed. *MD* and *ND* are equal radii, as are *ME* and *NE.* The two triangles are also congruent.

7. Of the five methods, which do you prefer? Why?

Answer: Answers may vary. Students may obviously prefer the perpendicular bisector tool.

> **Teacher Tip:** A discussion about preferred methods for constructing geometric figures and how technology has given us tools that were not available in classical constructions many years ago might push students to recognize how technology has really changed the way we do and think about some mathematics.

Wrap Up

Upon completion of the discussion, the teacher should ensure that students understand:

*   The different ways to construct a perpendicular bisector.
*   What it means to "construct" as opposed to just "draw."

Assessment

Have students open a new document, construct a segment, and then construct the perpendicular bisector using any one of the first four methods—without using the Creating_Perpendicular_Bisectors_Create document.

TI-Nspire Navigator

Note 1

Question 1, *Screen Capture:* While students create the document, use *Screen Capture* to assess students' progress. Assist students as necessary.

Note 2

Question 2, *Live Presenter:* While students create the document, select a student as the *Live Presenter* to illustrate how to do any of the five methods.