Mondrian in Motion: Parallel and Perpendicular Lines

For GSP5 ACTIVITY NOTES

INTRODUCE

Project the sketch for viewing by the class. Expect to spend about 15 minutes.

1. Display images you have collected of Piet Mondrian's work and invite students to share what they observe, including observations about the geometric objects. Some students are likely to use the terms *parallel* and *perpendicular*. To assess students' understanding of these terms and to get them thinking about them, ask what these words mean. Don't offer definitions at this time.
2. Explain that students will explore these types of lines as they create their own works like Mondrian's, using Sketchpad. Open **Mondrian in Motion.gsp.** Using the worksheet and the procedure listed below, model what students will need to know to work on their own. (Students will benefit from doing some steps without having seen them first.)
   - Model steps 1–11, omitting step 4. Call special attention to the process in step 9 for constructing a polygon. (Note that you are also constructing vertices at the intersections of the lines.)
   - Show how to choose **Edit | Undo** to back up a step if you want to do something differently.
   - Choose the **Point** tool and then model locating the menu commands **Edit | Select All Points** and **Display | Animate Points.** Explain that students will use these commands when they have completed their artwork.
   - Press *Show Point A* to reveal a point *A* that lies on the blue line. Explain that students do not need to show point *A* at the beginning of their work. It will be used in the last step.
   - If you want students to save their Sketchpad work, demonstrate choosing **File | Save As,** and let them know where to save.

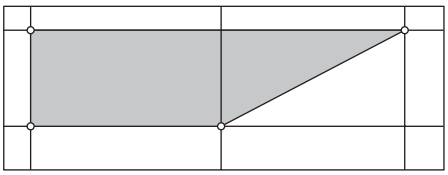
DEVELOP

Expect students at computers to spend about 30 minutes.

3. Assign students to computers and tell them where to locate **Mondrian in Motion.gsp.**
4. Distribute the worksheet and tell students to work through steps 1–15. Encourage students to ask their neighbors for help if they have questions about using Sketchpad.

5. Let students work at their own pace. As you circulate, here are some things to be alert to as students work through the worksheet steps.

   - In steps 3 and 5, students may prefer to construct their parallel and perpendicular lines one at a time by selecting the blue line and *a single point* and then choosing **Construct | Parallel Line** (or **Perpendicular Line**).
   - Steps 3–6 prompt students to make the connection between their constructed lines and their ideas about the meanings of *perpendicular* and *parallel.*



   - In steps 9 and 10, students are to construct and color in rectangles. If students forget that they are to construct rectangles (which include squares), they may construct a quadrilateral such as the one shown here. If you see this happening, bring students' attention back to the directions and to the shapes used in Mondrian's work.
   - In step 10, you may suggest that students construct and color as many rectangles as they choose, if time allows.
   - Once students have colored in shapes, they animate the points, which move freely in the plane. Students should notice that as the points move, the lines maintain their relationships, parallel or perpendicular, to the blue line.
   - In step 15, having students drag point *A* is intended to prompt them to consider what happens to their constructions when the blue line is no longer vertical. Students may be surprised to see that all the lines rotate along with the blue line and that the colored shapes remain rectangles. Note which students are comfortable with this and which continue to drag point *A*, unconvinced that this will be true no matter how they drag the blue line.

If you have a flash drive, use it to collect students' sketches for displaying on the shared computer. You can also share the artwork by holding a gallery walk.

6. Make sure students have "signed" their artwork. Have them save their sketches for the class discussion to follow, preferably in a place that will be accessible to the computer connected to the large-screen display.
7. If students will print their work, give the following instructions now.
   - Using the **Arrow tool**, select point *A* and the blue line. Now choose **Display | Hide Objects.**
   - Choose **File | Print Preview.**
   - In the dialog box that appears, set the image to appear on one page and then click **Print.**

SUMMARIZE

Project the sketch on a large-screen display for viewing by the class. Expect to spend about 10 minutes.

8. Bring the class together to discuss what they have experienced and observed. Invite students to reflect on their ideas about parallel or perpendicular lines. You may wish to introduce questions such as these into the discussion.

   What happens to the lines as you drag point A? Why? Students should realize that the lines remain parallel and perpendicular, even though their orientation, locations, and distances from one another change.

   Can you drag any of your points to make a line that is not parallel or perpendicular to any other line? Why? Students should begin to see that the lines always remain parallel or perpendicular to the blue line because they were constructed that way. The relationship the lines have to the blue line cannot change.

9. Continue the discussion, inviting students to share their thinking about the quadrilaterals in their work. Some questions to introduce follow.

   What happened to the quadrilaterals as you dragged point A? Students should realize that the quadrilaterals remain rectangular as their orientation, locations, sizes, and proportions change. (Students are also likely to mention that when two rectangles overlap, their intersection may be a new color.)

   What shapes are the colored figures in your artwork? Students may at first describe the shapes as rectangles and squares.

It's also possible in Sketchpad for one or both dimensions of a rectangle to go to zero, in which case the rectangle disappears.

Can you use the word* quadrilateral *to describe any of the shapes you see? Elicit the idea that all the shapes are four-sided polygons, so all the shapes are quadrilaterals.

What else can you say about all these shapes? Elicit the fact that the *opposite* sides of these quadrilaterals are parallel. Quadrilaterals whose opposite sides are parallel are called *parallelograms*, and specific parallelograms that the students see are called rectangles and squares. Students may also note that all the angles in these parallelograms are right angles.

What is true about the parallelograms called rectangles or squares? Parallelograms whose adjacent sides are perpendicular are rectangles and squares. All the angles are right angles. You may want to ask students to name and draw some parallelograms that do not have four right angles.

ANSWERS

4. Answers will vary. Possible answer: The lines are always parallel to the blue line. They never intersect the blue line, although they can coincide with it or move to the other side of it.

6. Answers will vary. Possible answer: These lines are perpendicular to the blue line. They cross the blue line at right angles.

7. Answers will vary depending on students' understanding of classes of shapes. It's possible to identify rectangles and squares, all of which can also be identified as quadrilaterals and parallelograms.

8. No.

13. Answers will vary. Possible answer: The lines stay parallel or perpendicular to the blue line. The shapes are still rectangles but they stretch and shrink.

15. Answers will vary. Possible answer: The lines remain parallel and perpendicular, and the quadrilaterals remain rectangles, even though the orientation, locations, sizes, proportions, and distances may change.