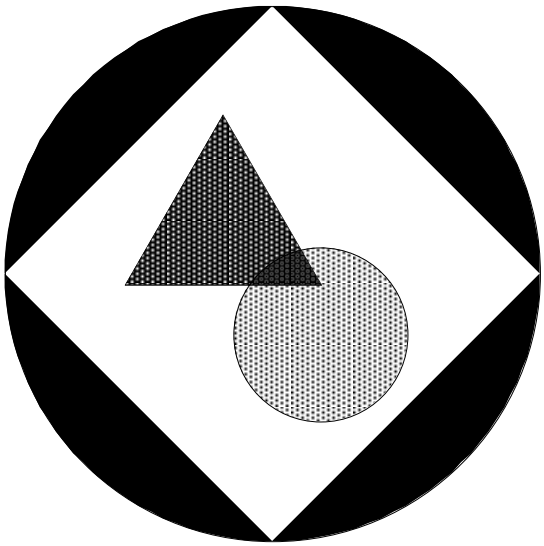
Professional Development Workshop Guide

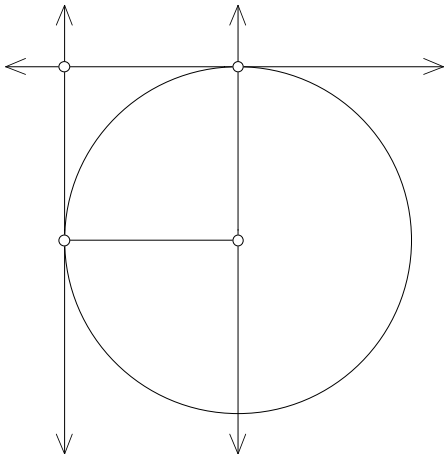


The Geometer's Sketchpad®
Workshop Guide

Key Curriculum Press
Innovators in Mathematics Education

Tour 1: Constructing a Square

In this tour, you'll learn about Sketchpad's basic tools and get a first taste of constructing a geometric figure—a square.



What You Will Learn

- How to construct segments and circles
- How to select and drag objects
- How to construct lines that are perpendicular or parallel to other lines
- How to construct points at the intersection of two objects
- How to save Sketchpad documents
- How to use the **Undo** command to backtrack through your actions

Free Play

Presenter: Once all participants have launched Sketchpad, allow about 10 minutes for Free Play. Stop once all the participants have completed this section.

To begin learning about Sketchpad, you'll want to experiment with the various tools. We'll start this tour by encouraging you to do just that, giving you just a little guidance.

1. Start Sketchpad. If Sketchpad is already running, choose **New Sketch** from the File menu.

You'll learn more about each of these tools throughout the tours.

2. Use the **Point, Compass,** and **Straightedge** tools to draw objects in the sketch plane. (Make sure you use all three straightedge tools—the **Segment, Ray,** and **Line**.) After you've used each tool at least once, use the **Selection Arrow** tool to drag different parts of your sketch. Then try the following tasks:
   - What happens when you use the **Selection Arrow** to click on the intersection of two straight objects, two circles, or a straight object and a circle?
   - What happens when you hold down the Shift key when constructing a segment or other straight object? Is a straight object constructed this way restricted when dragged in the future, or can it be dragged like any other straight object?
   - Use the **Compass** tool to draw a circle. Use the **Point** tool to construct a point on the circumference of that circle. Use the **Selection Arrow** to drag, in turn, each of the three points. How does dragging each point affect the construction?
   - Draw a segment with one endpoint "on top" of another segment or circle. How does this endpoint move when you drag it with the **Selection Arrow**? What happens if you move the segment or circle on which it's constructed?

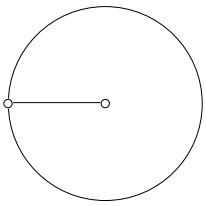
- What happens when you use the **Selection Arrow** to click on an object? What happens if you click again on the same object? What happens if you click in empty space?
- Using the **Point** tool, construct three independent points. Use the **Selection Arrow** to select and drag just one of those points. Now drag two of them at the same time. Then try dragging all three. Now what if you only want to drag one?
- Using the **Arrow** tool again, select one or a small number of objects. See what commands are available in the Construct menu and try some out.

Presenter: Stop here and answer questions. Go over those items above that seemed to generate the most questions. Make sure participants understand how selection highlighting determines which objects are dragged and how target highlighting determines which object gets constructed on which other object. Mention that selection also controls the availability of menu commands. Allow 15 minutes for the rest of this activity.

Getting Serious

3. When you're ready to move on, do the following: Choose **Undo** from the Edit menu—or, better yet, press Ctrl+Z on Windows or ⌘+Z on Mac—to backtrack through your work.
4. You should now be working in a blank sketch. Choose the **Segment** tool from the Toolbox (make sure it's the **Segment** tool, not the **Ray** or **Line** tool).
5. Draw a segment to form the bottom side of your square.
6. Using the **Compass** tool, click first on the right endpoint and then on the left endpoint of the segment. Each endpoint should highlight when you click on it. This constructs a circle centered at the right endpoint of the segment and passing through the other endpoint.
7. Using the **Selection Arrow** tool, drag each of the two points in the sketch to be certain that the circle is attached to the segment. If it's not, and there are actually more than two points in the sketch, **Undo** the last step in your sketch and redo step 6.
8. Click with the **Arrow** in blank space to deselect all objects.

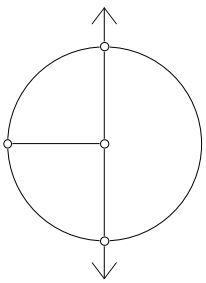
After step 5



After step 6

Constructing Perpendicular and Parallel Lines

Next you'll construct a line through the center of the circle and perpendicular to the segment. Notice that we had to state both of those pieces of information—"through the center of the circle" and "perpendicular to the segment"—to be clear which line we meant. Similarly, Sketchpad needs two items to be selected—a point and a straight object—in order to construct a perpendicular (or parallel) line.



After step 10

9. Select the segment and its right endpoint by clicking on them with the **Arrow**. Choose **Perpendicular Line** from the Construct menu.

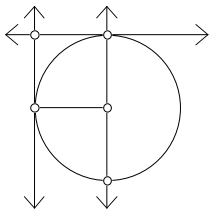
10. With the line still selected, select the circle as well. Then choose **Intersections** from the Construct menu.

To construct a parallel line, Sketchpad needs to be given a straight object to be parallel to and a point to pass through (just as with perpendicular lines).

11. Deselect all objects by clicking in blank space. Select the topmost point just created and the original segment. Then choose **Parallel Line** from the Construct menu.

12. Use either **Perpendicular Line** or **Parallel Line** to construct a vertical line through the left endpoint of the original segment.

13. Deselect all objects. Select the two lines from the last two steps and choose **Intersection** from the Construct menu.



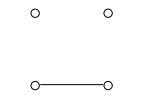
After step 13

Completing the Construction and the "Drag Test"

Before you finish your square, let's see if it passes the "drag test." As you did in step 7, use the **Selection Arrow** to drag each of the four vertices. Does everything stick together? If so, great! If not, **Undo** steps until you figure out what went wrong and try constructing the figure again. Then move ahead to finish the figure.

14. Select everything *except* the four corners of the square and the original segment.

15. Choose **Hide Objects** from the Display menu. You should see only what's in the figure at right. If there's more in your sketch, hide whatever is extra. If there's less, choose **Undo Hide Objects** from the Edit menu and try step 14 again.



After step 15

16. Using the **Segment** tool, construct the remaining three sides of the square.

Voilà! You have now made your first Sketchpad construction!

Is your figure a square no matter how you drag its parts? If not, it's not a true Sketchpad square. This is the essence of the "drag test."

17. Use the **Selection Arrow** tool to once again drag different parts of your square.

18. Choose **Select All** from the Edit menu to select the entire square. Now choose **Animate Objects** from the Display menu. Animating a construction in this way is an alternative to the drag test.

19. Choose **Stop Animation** from the Display menu. (You could also click on the Stop button in the Motion Controller.)

20. Keep your sketch open, as you may use it in a later activity.

Presenter: Stop here, review the construction of the square, and answer questions. Review the importance of selecting the appropriate objects (and only *the appropriate objects) before choosing a menu command. Give an example of a square that doesn't pass the drag test.*

Further Challenges

- See if you can construct the following objects: a rectangle, a parallelogram, a rhombus, a trapezoid, and an equilateral triangle.