


- An excerpt from “Exploring with KIBO” by KinderLab Robotics, Inc. •

Grade 3, Lesson 7 :: Recommended time, 1 hour

DRAWING SHAPES

Parts Needed	Topics	Cross-Curricular Connections
 <p>Marker Extension Set</p>	Algorithms (Decomposition; Comparison)	Math (CC.Math.3.MD.5–8: rectangular shapes)

OVERVIEW

Students will program KIBO to draw specific shapes. They will consider how to break shapes down into a sequence of KIBO movement paths, and compare different approaches to drawing the intended shape. Students will engage with grade-level math standards related to rectangles.

LEARNING GOALS

Students will:

- Program KIBO to draw specific shapes
- Compare the different ways KIBO draws when markers are attached differently
- Define and measure rectangles
- Compare algorithms for drawing the same shape

BACKGROUND

A rectangle is a shape with four sides and four 90 degree angle corners. The lengths of each pair of opposing sides are the same. If all four sides are the same length, the rectangle is a square. The area of a rectangle is the length of one side times the length of a neighboring side.

PREPARATION AND MATERIALS

For all lessons involving the Marker Extension Set, you will need a surface for KIBO to move and draw on. We recommend taping large sheets of paper (butcher paper rolls, or similar) to the floor, or using an erasable cloth surface like plastic tablecloths or drop-cloths. We also recommend using only washable markers. (The markers included in the Marker Extension Set are washable.)

Each group will need a measuring tape or yardstick. If measuring tapes are a new tool for students, plan to spend some time showing students how this tool works.



INSPIRE: Drawing Shapes

“In earlier lessons we’ve learned how to attach markers to KIBO and programmed KIBO draw as it moved. Today we will try programming KIBO to draw specific shapes. We’ll start with an open ended experiments to draw any shapes we want, then we’ll focus in on drawing rectangles.”

Ask students to share what they know about rectangles, from their work with this shape in their Math curriculum. Discuss.



CONNECT: Shape Search!

Have the students walk around the classroom looking for examples of objects with simple shapes: a circular wall clock, a rectangular window, a square cubby. Encourage them to look for more complicated shapes as well, like half-circles, hexagons, or irregular shapes. Ask students to sketch the shapes that interest them in their journals or notebooks.



ENGAGE: Programmed to Draw

Activity 1 – Drawing Any Shapes

Each group will try to have KIBO create shapes from their Shape Search drawings. They should choose a shape from their journal/notebook and plan a program that might draw that shape. They can scan and test the program with their KIBO, with a marker attached. After observing the result, they can experiment with changing the programs and changing how the arms are attached. Changing which side of KIBO the arm is on, which position the arm is in, and whether it is attached with one pin or two all change the resulting drawings, especially when KIBO is turning. Encourage students to explore all of these options as they try to make KIBO re-create their shapes.

Tip: to help children think about how to program KIBO, prompt students to reflect on how their own hand and pen move when they draw shapes themselves: long straight movements for sides, turns for corners. They can reflect back on the drawings they did during the warm-up, or make new drawings while paying attention to their movements.

Here are some suggestions for shape programs:

- Square: BEGIN – REPEAT:4 – FORWARD – RIGHT – END REPEAT – END
- Circle: BEGIN – SPIN -or- REPEAT:4 – RIGHT – END REPEAT – END (with a fixed marker)
- Spiral: BEGIN – SPIN – END (with a marker at the end of two or three arms attached in a chain)
- Starburst: BEGIN – SPIN – FORWARD – BACKWARD – END (run this over and over again)

Tip: Some shapes, like triangles, cannot be represented simply as a sequence of KIBO movements. For some shapes, children may need to re-position KIBO by hand during the run of the program. Engage students in reflection about

this, encouraging them to think about why some shapes are easier to draw with KIBO's movement commands than others.

Transition: Ask each group to share an experience they had when they tried to create a specific shape. They might share a program, a technique for attaching the markers, or an actual drawing on their paper. Encourage them to compare KIBO's movements to how a person might draw: Is it similar or different?

Activity 2 – Drawing Rectangles

In part 2, each group will program their KIBO to draw a rectangle specifically. Remind students that a rectangle has four sides, and the opposing sides are the same length.

Tip: A rectangle is a straightforward shape for KIBO to draw, because of the generally straight lines and 90-degree turns made by KIBO. However, groups will still encounter challenges as the corners made by the Marker Extension Set will change based on how the markers are attached to the arms, and where the arms are attached to the frame.



Ask students to decide how long each side of their rectangle will be, in units of KIBO “forward steps”. Then they should design a program that causes KIBO to travel along a rectangular path to draw the shape.

Encourage groups to experiment with different programs they might use to create a rectangle. For example, a “rectangle program” might be:

- A single FORWARD block which students run repeatedly, turning KIBO by hand
- A long series of FORWARD and TURN blocks
- Nested REPEAT loops enclosing FORWARD and TURN blocks

They should test and revise their programs as needed, observing the drawing KIBO makes as it travels. Ensure that each group has a chance to draw one “final” rectangle with the marker attached before moving on to the Reflect step.

Finally, ask students to use their ruler or measuring tape to measure the lengths of their rectangle's sides in standard units (inches or centimeters). Ask each group to record their rectangle's dimensions in their journals, using both the standard units the number of FORWARD steps.



REFLECT: Comparing Algorithms

At the closing meeting, ask groups to share their observations about different programs they used to create rectangles. How does using a repeat loop change the program, compare to using a long series of FORWARD blocks? Which program is easier to understand, to debug, or to scan?

After the lesson is complete, collect and save the drawings for creating the gallery in Grade 3, Lesson 8.