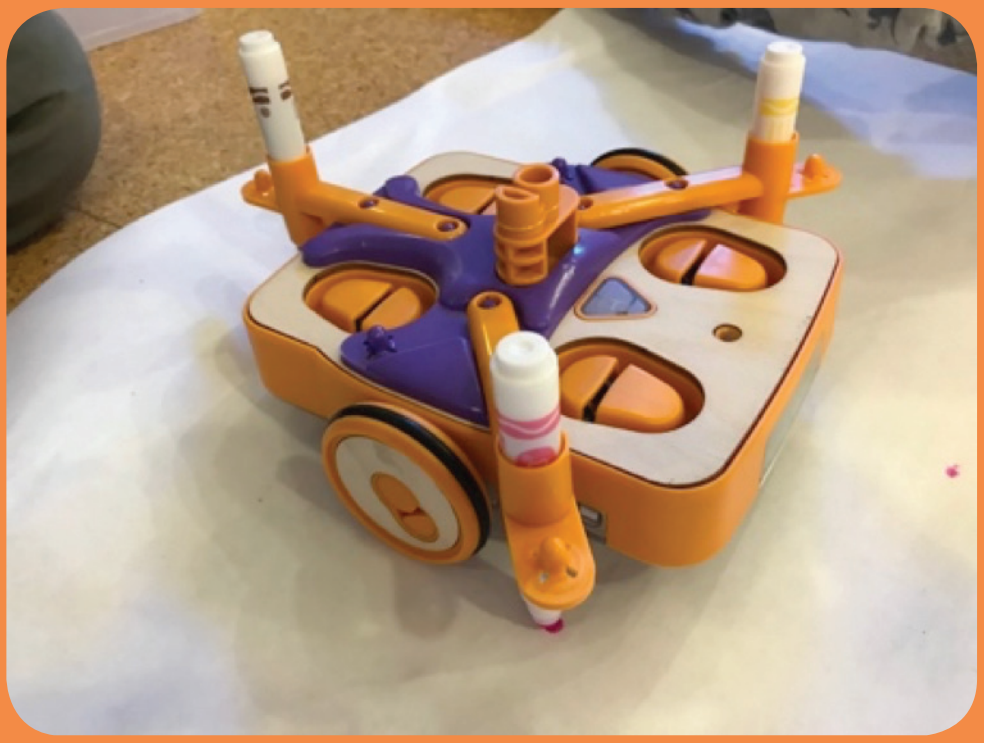
An excerpt from the Guide:

Make Learning Visible!

Exploring Engineering, Mathematics, Literacy, and Art with the KIBO™ Marker Extension Set



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ACTIVITY 3: Shapes and Letters

(1–1.5 hour activity)

Powerful Ideas: *Representation, Modularity, and Control Structures with REPEAT*

Overview: Today, students will undertake some drawing challenges. Students will try to program KIBO to draw specific shapes and letters. Which shapes can KIBO draw? After KIBO has made lots of lines, students will stop and reflect on the drawings, looking for emergent shapes and letters. The time dedicated to this lesson can vary depending on whether you want to include both shape drawing and letter drawing in the lesson.

Learning Goals

After this lesson, students will be able to:

- program KIBO to draw specific shapes and letters
- compare the different ways KIBO draws when markers are attached differently

Materials / resources:

Required materials/resources:

- ❑ One KIBO 10 Kit or higher per group. *This lesson requires only:*
  - ○ KIBO body
  - ○ Motors and wheels
  - ○ All motion blocks
  - ○ REPEAT and number parameters (2, 3, 4, FOREVER)
- ❑ One Marker Extension Set per group. *Note: It may be helpful to limit each group to one marker for this lesson. Multiple markers can be distracting in a more precise activity like today's lesson.*
- ❑ Large sheets of paper taped to the floor, on which KIBO will drive and draw (poster board, rolls of butcher paper, or similar large surfaces). Ideally, each group should have an area roughly 4 feet by 4 feet.
- ❑ Engineering Design Journals, notebooks, or loose paper, for students to draw shapes

Optional materials/resources:

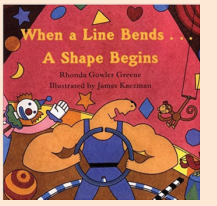
- ❑ Recommended reading: *When a Line Bends, a Shape Begins* by Greene and Kaczman

Activity Description

Warm-up: Shape Search! (10 minutes): "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. With older students, encourage them to look for more complicated shapes, like half-circles, hexagons, or irregular shapes. Ask students to draw those that interest them in their journals or notebooks.

Introduce the concepts and the task (15 minutes): "Last week we learned all about the ways we can attach markers to KIBO, and how to program KIBO to draw." Lead the students in a discussion reminding them of the things they learned last week. "Today we will program KIBO to draw specific shapes, like the ones we just found in our shape search. We'll also see if we can make KIBO write letters."

Recommended Reading: *When a Line Bends, a Shape Begins...* by Greene and Kaczman. This book helps children see lines and shapes in all sorts of everyday objects. This will set the stage for showing how KIBOs lines can combine to create complex shapes.



Activity 1

Draw the shape (25 minutes): Each group will try to have KIBO create as many shapes as they can 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.

Classroom 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.

If students would like to get up and move, you might ask them to act out the program of their shapes with their whole bodies, as in a game of KIBO Says.

For regular shapes (like a square), encourage students to experiment with repeat loops. If children have not yet mastered repeat loops, they should feel free to run the same program repeatedly.

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)

Classroom 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.

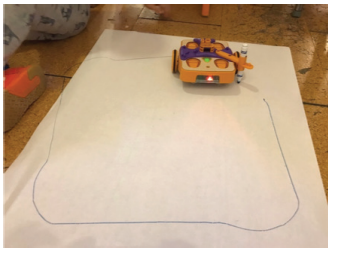
Technology Circle / Activity Transition (10 minutes): Call students to a circle. Ask each group to share an experience they have when they create a specific shape. They might share a program, a technique for attaching the markers, or an actual drawing on their paper. Encourage them to compare KIBOs movements to how a person might draw: is it similar or different?

Before leaving the circle, introduce the next activity. Each group will take what they've learned and try to program KIBO to write a letter. They might pick the first letter of their name, or another favorite letter.

Classroom tip: Activity 2, below, is appropriate for older children Gr 1–2; you may wish to skip Activity 2 with younger children, or if you have less time available.

Activity 2

Draw the Letter (20 minutes): This activity works like the first, but the goal is to plan, test, and refine programs and marker attachments to draw a letter. Students may need to combine multiple short programs, moving KIBO in between programs. This is alright; the goal is to get them thinking about the process and breaking down the letter into KIBO movements. They should record their program in their journals/notebooks.



Closing Reflection (10 minutes): Ask students to step back and look at everything that KIBO has drawn. By now, there will likely be lots of marks on all of the papers! Ask students to do another "Shape Search", but this time they should walk around all of the KIBO drawings on the floor. Ask students to name shapes they discover, and to read letters they find. Some of the shapes and letters will be intentional, and others will emerge by surprise from the many marks KIBO has made. This search will reinforce students' shape and letter recognition skills.

After the lesson is complete, collect and save the drawings for creating the gallery in Activity 6.