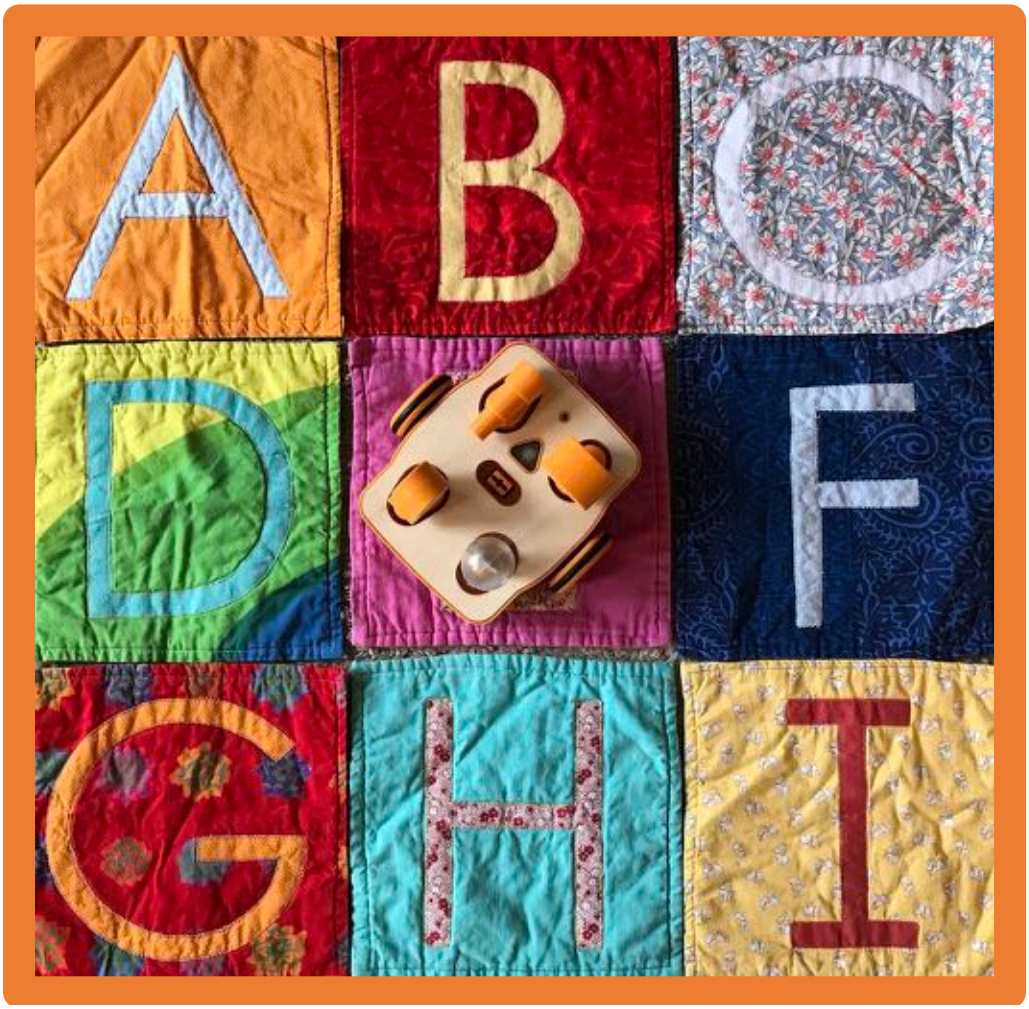
Maps, Measurement, and Make-Believe

An Introduction to Floor Map Activities with the KIBO™ Robot



KinderLab robotics

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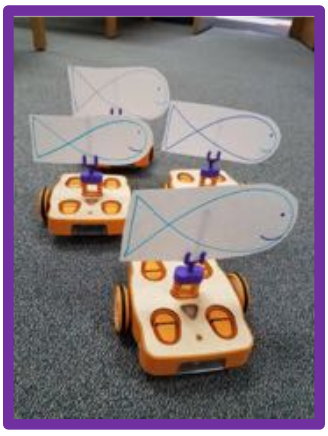
KIBO Robotics and Floor Maps

Floor maps are a perfect complement to KIBO's tangible, hands-on approach to coding. KIBO's journey across the floor map becomes a story told by the children who program it. Through a combination of code and imagination, a floor map becomes a world for children to enter and explore with KIBO. A floor map can represent a physical space, like a student's neighborhood, an animal's natural habitat, or the solar system. It can represent an imaginative space, like the setting of a storybook. And it can even be a concrete representation of an abstract space, such as a palette of all of the class' favorite things, a number line, or a coordinate grid.



KIBO is a robot kit specifically designed for young children aged 4–7 years old. With KIBO, children build, program, decorate, and bring their own robot to life. KIBO is entirely screen free, as children program their robots with "tangible code" made of wooden blocks. KIBO is supported by over 15 years of research, led by KinderLab co-founder Marina Umaschi Bers, PhD., professor at the Eliot-Pearson Department of Child Study and Human Development and director of the DevTech Research Group at Tufts University.

Floor map activities with KIBO have a natural connection to mathematics and geometry through measurement and estimation of distances. But the fundamental principle of creating a physical space for KIBO to explore – giving children concrete representations to think with – can span all the disciplines. Floor maps of storybook worlds, countries, neighborhoods, and even simple picture grids can provide connections to any subject. Floor map activities get kids moving and collaborating in physical space around concrete objects – enhancing the strengths of using KIBO in the classroom.

This booklet describes **eight activities** using floor maps to address learning standards in math, ELA/literacy, science, social studies, and design. Our goal is to inspire you to use KIBO in new ways with floor maps. In each activity, we provide pointers to curriculum or KIBO Resources where you can find these ideas explored in more detail.

Floor Map Activity Learning Goals

All floor map activities in this guide reinforce important early childhood skills:

- Direction and position terms (left, right, forward and back), as children plan KIBO's movement
- Measurement and estimation, as children gauge distances for KIBO to travel
- Sequencing, as children turn their movement ideas into a program for KIBO
- The engineering design process, as children test and refine their programs

All of the activities also support the following Computer Science Teachers Association (CSTA) standards:

- 1A-AP-08: Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks.
- 1A-AP-10: Develop programs with sequences and simple loops, to express ideas or address a problem.
- 1A-AP-11: Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.

Cross-curricular Standards Addressed

How Far to the Star? Common Core Math Standards in measurement and estimation	CCSS.MATH.CONTENT.K.MD.A.1 CCSS.MATH.CONTENT.1.MD.A.2 CCSS.MATH.CONTENT.2.MD.A.1 CCSS.MATH.CONTENT.2.MD.A.2 CCSS.MATH.CONTENT.2.MD.A.3 CCSS.MATH.CONTENT.2.MD.A.4
The KIBO Number Line Common Core Math Standards in counting, adding, and subtracting	CCSS.MATH.CONTENT.K.OA.A.1 CCSS.MATH.CONTENT.1.OA.C.5 CCSS.MATH.CONTENT.1.MD.A.2 CCSS.MATH.CONTENT.2.MD.B.6
One Letter at a Time Common Core ELA Standards in foundational reading skills	CCSS.ELA-LITERACY.RF.K.1.B CCSS.ELA-LITERACY.RF.K.1.D CCSS.ELA-LITERACY.RF.K.3.A CCSS.ELA-LITERACY.RF.K.3.C
Exploring the Story Common Core ELA Standards in reading of literature	CCSS.ELA-LITERACY.RL.K.1 CCSS.ELA-LITERACY.RL.K.2 CCSS.ELA-LITERACY.RL.K.3 CCSS.ELA-LITERACY.RL.1.1 CCSS.ELA-LITERACY.RL.1.2 CCSS.ELA-LITERACY.RL.1.3 CCSS.ELA-LITERACY.RL.2.2 CCSS.ELA-LITERACY.RL.2.5
Our Community, Our World National Curriculum Standards for Social Studies	"In the early grades, young learners draw upon immediate personal experiences in their neighborhoods, towns and cities, and states, as well as peoples and places distant and unfamiliar, to explore geographic concepts and skills. They learn to use maps, globes, and other geographic tools."*
The Historical Journey National Curriculum Standards for Social Studies	"Children in early grades learn to locate themselves in time and space. They gain experience with sequencing to establish a sense of order and time, and begin to understand the historical concepts that give meaning to the events that they study."*
The KIBO Habitat Next Generation Science Standards in life science systems	NGSS K-ESS3-1 NGSS 2-LS4-1
Up, Down, and Around Next Generation Science Standards in engineering and design	NGSS K-2-ETS1-1 NGSS K-2-ETS1-2 NGSS K-2-ETS1-3

* *National Curriculum Standards for Social Studies: A Framework for Teaching, Learning, and Assessment https://www.socialstudies.org/standards/introduction*

How Far to the Star?

The big idea: *A floor map can be a space to conduct measurement using standard and non-standard units and scientific tools like rulers and measuring tape. Students predict, test, and measure KIBO's travels from point to point on the floor map.*

Cross-curricular learning goals:

- Students make and test predictions
- Students measure length and distance using standard and improvised units
- Students learn to use measuring tape
- Common Core Math (see Standards table)

Procedure:

1. Tape off a large square area on the classroom floor (appx 6' x 6'). Cut out and tape down several large star shapes at various points within the square.
2. Demonstrate a KIBO program with just one FORWARD block. Engage students in a discussion about how far KIBO traveled. Ask students to estimate how many of these "KIBO Units" separate some of the stars on the floor map.
3. Starting from a chosen star, students create programs to move KIBO to another destination star. They test and refine their programs until KIBO travels the correct distance.
4. Students record how many "KIBO Units" the journey took. Students measure the same distance using rulers or measuring tape.
5. Close with a discussion of these two different kinds of measurement.
    - Extend this investigation by asking students to measure other distances in the classroom – dimensions of a rug, distances between activity centers – using "KIBO Units".

What's Next? Find more activities like this in KIBO curriculum:

Make Learning Visible "Activity 4: Measure Our Town"

KIBO Activity Center Guidebook "KIBO Bowling"

KIBO Resources: "KIBO Mark and Measure"

Non-Standard Measurements: The Smoot Bridge

In KIBO's home town of Boston, one of the bridges over the Charles River has an unusual length: 364.4 Smoots. This non-standard unit corresponds to the height of MIT student Oliver Reed Smoot. With help from his friends, Smoot laid himself down head-to-toe along the entire length of the Harvard Bridge, marking the distance each time. The Smoot measurements are now maintained and repainted as an official part of the bridge. How many KIBOs long would the Smoot Bridge be?

Photo: "100-Smoot marking on Harvard Bridge" by dvortygirl. (CC BY-SA 3.0)

The KIBO Number Line

The big idea: *A number line is a one dimensional map. A physical number line on the classroom floor allows children to explore math concepts by sending KIBO physically forward and backward on the line. Students can even solve addition and subtraction problems with their "counting KIBO."*

Cross-curricular learning goals:

- Students practice counting
- Students add and subtract on a number line
- Students represent addition as "counting on" operations
- Students create algorithms to solve a problem
- Common Core Math (see Standards table)

What's Next?
Find an expanded version of this activity in our KIBO curriculum:

KIBO Activity Center Guidebook "KIBO Number Line"

Procedure:

1. Lay out a long line of masking tape on the classroom floor. Mark off "KIBO units" on the tape by sending KIBO along the line, one FORWARD block at a time.
2. Children create KIBO programs with multiple FORWARD blocks (or REPEAT loops), then count along with KIBO as it moves forward the programmed number of times.
3. Children create addition and subtraction programs as combinations of FORWARD and BACKWARD commands; wherever KIBO ends up on the number line is the solution to the equation. For example, four FORWARDs followed by one BACKWARD represents the subtraction operation "4 minus 1": the KIBO will end up at "3" on the number line.

One Letter at a Time

The big idea: *A floor map can be as simple as a collection of destinations that students program KIBO to visit. By scattering letter or word cards across the floor map area, you can create an environment to support letter recognition, spelling, and foundational reading skills.*

Cross-curricular learning goals:

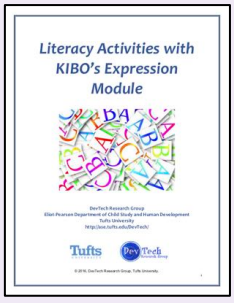
- Students practice letter recognition
- Students practice making sound/letter correspondence
- Students practice basic spelling
- Students recognize sight words
- Common Core ELA (see Standards table)

Procedure:

1. Within a marked-off floor area (6' x 6'), tape down letter cards. (This activity can also work well with classroom alphabet floor rugs.)
2. Depending on the age of the students:
    - Speak a letter sound or name, and challenge students to program their KIBO to travel to the letter you spoke.
    - Speak a word, and challenge students to program their KIBO to spell the word by traveling from letter to letter in sequence.
    - Instead of letter cards, tape down cards with age-appropriate sight words. Then challenge students to send KIBO to the card matching the word you call out.

What's Next? Find more activities like this in KIBO curriculum:

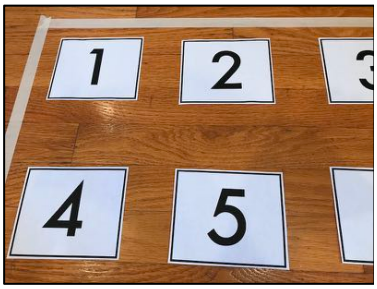
Make Learning Visible "Activity 3: Shapes and Letters"



Literacy Activities with KIBO's Expression Module (Tufts DevTech)

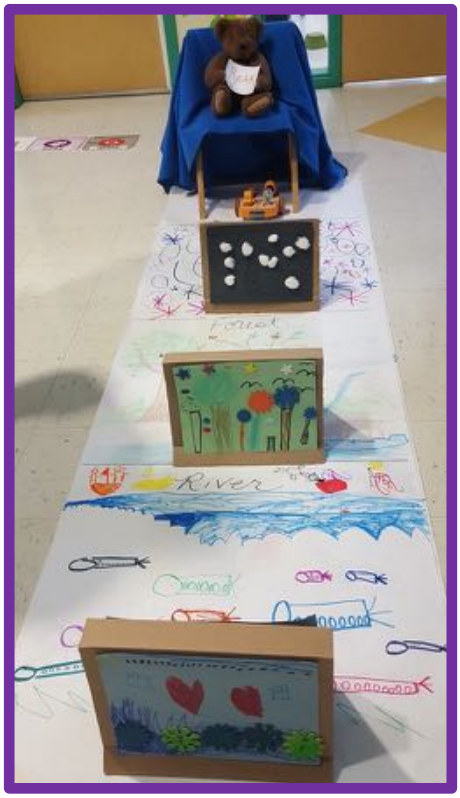
"Go to the Spot" Activities

The basic structure of this activity can be adapted to any domain. By changing the content of the cards on the floor map, students can engage with different subjects as they practice their KIBO directional programming and problem solving.



You could place cards with animal pictures on the floor map, and challenge students to program KIBO to travel to the animal whose name you call out. Or place cards with numbers on the map, then challenge students to program KIBO to count or add.

Exploring the Story



The big idea: *Many favorite storybooks involve a journey in an imaginary world: Max's journey to the island of the Wild Things, Pooh and Christopher Robin's wanderings in the Hundred Acre Wood, the family's quest through the sensory-rich environments of We're Going on a Bear Hunt. Students can engage more deeply with classroom literature by creating a floor map to represent the story space, and programming KIBO to re-tell, re-imagine, and re-enact a scene from the book.*

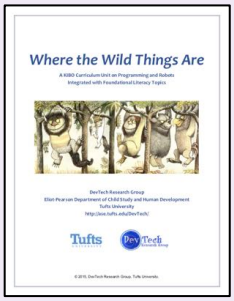
Cross-curricular learning goals:

- Students develop foundational reading comprehension skills by re-telling a scene from a storybook
- Students learn about setting in narrative
- Students practice putting story events in sequence
- Students read and repeat lines from a storybook
- Common Core Literacy (see Standards table)

Procedure:

1. Select a class-favorite storybook, or storybook connected to the ongoing curriculum, that involves an engaging setting. Read and discuss the book; engage students in selecting a scene to recreate.
2. Students work together to create the setting as a large floor map.
3. In groups, students decorate their KIBOs as characters from the story and create programs to represent the action of their character with the scene or story. Reflect with students on the sequence of events in the story and to program their KIBOs to follow this sequence across the story map.
    - *If you have the Sound Record/Playback Module, kids can record themselves reading lines of dialogue from the book and include their own voices in the KIBO program.*
4. Close with a story showcase where students demonstrate their programs. Engage students in discussion about how their re-creation is similar to the story and how it is different.

What's Next? Find more activities like this in KIBO curriculum:



Where the Wild Things Are (Tufts DevTech)

KIBO Activity Center Guidebook "KIBO Story Line"

KIBO Resources: "Greek Gods and Robots"

Our Community, Our World

The big idea: *In early childhood, students begin to learn how their lives relate to a larger community and a larger world. A curriculum centered on students' own community is both relevant to their lives and a strong foundation from which they can begin to look outward. A community floor map is a perfect context for this exploration; KIBO can play the part of familiar vehicles like school buses and fire trucks as well as the people living in the town.*

Cross-curricular learning goals:

- Students reflect on the physical aspects of a community (streets, parks, homes; the natural and built landscapes)
- Students learn more about their own neighborhood
- Social Studies standards (see Standards table)

Procedure:

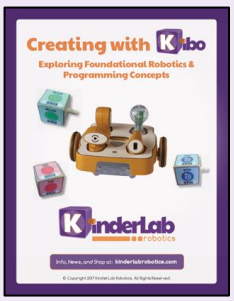
1. Organize a walk around the school's immediate neighborhood or just the school environment. Engage the students in discussion about the built and natural features of their neighborhood that they notice.
2. Students work together to create a floor map that represents the school's neighborhood. This does not have to be an accurate map! Students should add to the map elements that are personally meaningful for them, such as their homes, favorite parks or places, or things they noticed on the walk earlier.
3. Student groups decorate their KIBOs to represent an inhabitant of the community: KIBO might be a vehicle such as a school bus or police car, or might be a person or pet who lives in the neighborhood.
4. Students create programs to represent the life or routine of the character they created. Close the unit with a showcase showing the life of their neighborhood.

What's Next?

Find more floor-map activities like this one in KIBO curriculum:

Build It Better
"Final Project: KIBO Happy City"

KIBO Activity Center Guidebook
"KIBO Snowplow"



Creating with KIBO
"Lesson 4: What Are Repeats?"

The Historical Journey (or *The Travels of Marco KIBO*)

The big idea: *Learning about events elsewhere in the world and distant in history helps students understand their own lives, but these stories can seem abstract and remote for young children. A floor map can help students visualize the place where a historical event happened; and KIBO can represent a traveler in that place or a participant in the event. This approach brings the concrete, hands-on experience of working with KIBO to social studies and history.*

Cross-curricular learning goals:

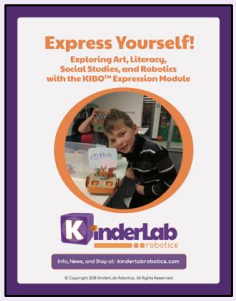
- Students learn about a historical event and its context
- Students explore fundamental skills in geography and cartography
- Students practice putting events in sequence
- Social Studies standards (see Standards table)

Procedure:

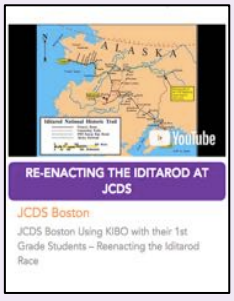
1. Select an event from history of interest to the class, relevant to the student's families' cultures of origin, or connected to the ongoing curriculum. Through stories, videos, sharing of artifacts, and class discussion, explore the chosen historical event with the students.
2. Students work together to create a floor map that represents the context of the event or culture studied. For example, students might create a large map of the world with their families' countries of origin marked. Or they might represent a historical journey like the 1925 delivery of diphtheria medicine along Alaska's Iditarod Trail.
3. In groups, students decorate their KIBOs as participants in the historical event. KIBO might wear costumes appropriate to the time, become a covered wagon, sailing ship, or dog-sled, for example.
4. Students create programs to represent the journey or sequence of events being studied.
    - *If you have the Sound Record/Playback Module, students can record facts for their KIBOs to speak, acting as "tour guides" the map. Even without this Module, the children can speak the lines themselves as their KIBO programs run.*
5. Close with a showcase where students demonstrate their KIBO historical journeys.

What's Next? Find more activities like this in KIBO curriculum:

Showtime with KIBO "Activity 2: KIBO Tour Guide"



Express Yourself "Activity 2: World Parade"



KIBO Resources "Re-Enacting the Iditarod at JCDS"

The KIBO Habitat

The big idea: *A floor map can represent the physical environment in which plants and animals live. Students explore life science relationships by creating the model of the ecosystem themselves. KIBO becomes an animal or plant within the ecosystem, and students code its behavior within the system.*

Cross-curricular learning goals:

- Students explore the concept of an ecosystem as a set of relationships between the physical environment and the living things within it
- Students model the appearance and behavior of a chosen animal (or plant)
- Next Generation Science Standards (see Standards table)

Procedure:

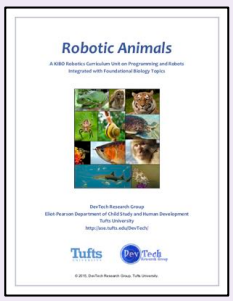
1. Select an environment / ecosystem of interest to the class. Use books, videos, nature walks, and discussions to engage children in study of the chosen ecosystem and the animals and plants that live there.
2. Students work together to create a model of the ecosystem. The overall ecosystem area should be large enough for multiple KIBOs to move within it.
3. Each group of 2-3 students selects an animal or plant within their ecosystem, then decorates their KIBO to look like the chosen organism. They also create a KIBO program to represent the animal or plant's behavior within the ecosystem. For example, a cautious animal might move away IF NEAR; a plant energized by the sun might spin around UNTIL DARK.
    - *Encourage groups to collaborate to have their KIBOs interact with one another within the shared ecosystem. Remember to call frequent Technology Circles to give students a chance to share challenges and successes.*
4. Finish the project with an "ecosystem showcase" to demonstrate the KIBO creatures in their habitats.

What's Next?

Find more activities like this in KIBO curriculum:

The KIBO Zoo curriculum

KIBO Activity Center Guidebook "KIBO Trained Pet"



Robotic Animals (Tufts DevTech)

Up, Down, Around

The big idea: *Let's think vertical! Topographical and relief maps represent the ascent and descent of a natural landscape. What if KIBO could explore these ups and downs too? How can we build slopes, and how do slopes change KIBO's movement?*

Cross-curricular learning goals:

- Students use sturdy building techniques to create tilted surfaces
- Students observe the impact of incline and friction on movement
- Students observe the effect of different sized wheels on movement
- Next Generation Science Standards (see Standards table)

Procedure:

1. Discuss and show examples of relief maps and topographical maps.
2. Engage the students in building a large scale "relief map" in the classroom using blocks, cardboard sheets, planks, and other large-scale building materials.
3. Invite the students to program KIBO to explore the environment they've constructed. Encourage open ended observations of the ways the slopes and surfaces affect KIBO's movement.
4. Provide materials that the students can attach to KIBO's wheels, such as: yogurt container lids, cardboard circles, tape with different qualities of smoothness. Encourage them to experiment with altering KIBO's wheels and observing the impact on KIBO's movement (see the sidebar for details).
5. Bring the students together in a Technology Circle to share their findings from this open-ended activity.

What's Next?

Find more floor-map activities like this one in our KIBO curriculum:

Make Learning Visible
"Activity 5: Curves, Arcs, and Circles"

KIBO Activity Center Guidebook
"KIBO Tractor Pull"

Different Wheels for KIBO

Can KIBO drive in circles? Try attaching a cardboard circle, yogurt lid, or other sturdy circle to one of KIBO's wheels. With different sized wheels, KIBO will curve toward the side with the smaller wheel.

What about the effect of different materials? When KIBO's wheels are smoother, does KIBO climb better or worse? How does KIBO climb on a rough surface?

When engineers make small changes in their designs, they can sometimes cause big changes in how their creations work!

Where to Go Next

You can purchase any of the KIBO curriculum materials mentioned in this guide at our web store at **shop.kinderlabrobotics.com**.

Lots of free resources and lesson plans — including the Tufts DevTech curricula referenced in this booklet — can be found at the KIBO Resources website:

resources.kinderlabrobotics.com

www.kinderlabrobotics.com @KinderLabRobot