# *Where the Wild Things Are*

**A KIBO Curriculum Unit on Programming and Robots**
**Integrated with Foundational Literacy Topics**

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## *Introduction to the Curriculum*

This curriculum introduces powerful ideas from computer science, specifically programming in a robotics context, to pre-kindergarten through $2^{nd}$ grade children in a structured, developmentally appropriate way.  While the curriculum is designed for KIBO robotics, the powerful ideas are applicable to other robotic construction kits. The term powerful idea refers to a central concept within a domain that is at once personally useful, interconnected with other disciplines, and has roots in intuitive knowledge that a child has internalized over a long period of time. The powerful ideas from computer science addressed in this curriculum include: the engineering design process, robotics, programming, repeat functions, and sensors. These powerful ideas are explored in the context of a curriculum that draws on the well-known children's book *Where the Wild Things Are* by Maurice Sendak, which is about a young boy named Max who makes mischief at home and then sails to the land where the wild things are.  This curriculum, however, can be adapted to many other early childhood themes. Each unit follows the same basic structure: 1) warm up games to playfully introduce or reinforce concepts, 2) introduction of the powerful idea through a challenge, 3) work individually or in pairs, 4) technology circle, and 5) free-explorations. The culmination of the unit is an open-ended project to share with family and friends. Teachers can adapt the lesson structure and its components to suit their unique class' needs.

Just as young children can read age-appropriate books, computer programming can be made accessible by providing young children with appropriate tools such as KIBO.

### Pacing

The curriculum unit consists of a minimum of 20 hours and it is designed to take place over the course of one intensive week of work (i.e. in a camp setting or during a robotics week at school) or over the course of a few months with one or two sessions per week. Depending on children's developmental levels and prior experience with technology, programming, and robotics, students might need more or less time than the guidelines here indicate. Each lesson in the curriculum can be spread out over several sessions to accommodate the classroom schedule and students' attention spans. Depending on the students, a class may benefit from between one and two hours to devote to their robotics and programming activities at a time. This curriculum provides suggested time allotments, but they should be adapted to suit the needs of each classroom.

Some students may benefit from further division of the activities into smaller steps or from more time to explore each new concept before moving onto the next, either in the context of free-exploration or with teacher-designed challenges. Each of the powerful ideas in this curriculum can easily be expanded into a unit of study. For instance, students could explore a range of different activities and challenges with sensors to learn how they work in more depth.

To supplement the structured challenges, two to three hours of free-exploration are allotted throughout the curriculum. These open-ended sessions are vital for children to fully understand the complex ideas behind their robotic creations and programs. The free-exploration sessions also serve as a time for teachers to observe students' progress and understandings. These sessions are as important for learning as the lessons themselves! In planning and adjusting the timeframe of this curriculum, free-exploration sessions should not be left by the wayside. Rather, if time is tight, teachers can consider leaving out a particular lesson altogether, giving children enough time to really understand the ideas they are introducing, instead of skimming over all the lessons presented in this curriculum. Free-exploration provides opportunities for playing with materials and ideas. This will help build a solid foundation.

## Materials

The robotics kit referred to in this curriculum is the KIBO robotics kit, developed by the DevTech Research Group at Tufts University and made commercially available through KinderLab Robotics, Inc. Another kind of material used in the curriculum is inexpensive crafts and recycled materials. The use of crafts and recycled materials, a practice already common in other domains of early childhood education, lets children build with a range of materials with which they are already comfortable with. There are many supplemental materials such as the KIBO Says cards, Expert Badges, and Engineering Design Journals that can be purchased through KinderLab Robotics. These are denoted with an asterisk (*). A full list of materials can be found in Appendix A.

## Pedagogical Framework: Positive Technological Development

The theoretical foundation of this curriculum, called Positive Technological Development (PTD), was developed by Prof. Marina Umaschi Bers and can be found in two of her books: Blocks to Robotics: Learning with Technology in the Early Childhood Classroom (Bers, 2008) Designing Digital Experiences for Positive Youth Development: From Playpen to Playground (Bers, 2012). More information is included in Appendix B.

The PTD framework guides the development, implementation and evaluation of educational programs that use new technologies to promote learning as an aspect of positive youth development. The PTD framework is a natural extension of the computer literacy and the technological fluency movements that have influenced the world of education but adds psychosocial and ethical components to the cognitive ones. From a theoretical perspective, PTD is an interdisciplinary approach that integrates ideas from the fields of computer-mediated communication, computer-supported collaborative learning, and the Constructionist theory of learning developed by Seymour Papert (1993), and views them in light of research in applied development science and positive youth development.

As a theoretical framework, PTD proposes six positive behaviors (six C's) that should be supported by educational programs that use new educational technologies, such as KIBO robotics. These are: creation, creativity, communication, collaboration, community building and choices of conduct.

This curriculum engages young learners in:

1. ***Content creation,*** by designing a KIBO robot and programming its behaviors. The engineering design process of building and the computational thinking involved in programming foster competence in computer literacy and technological fluency. The use of Engineering Design Journals document for the children themselves, as well as for teachers and parents, their own thinking, their learning trajectories and the project's evolution over time.
2. ***Creativity,*** by making and programming personally meaningful projects, problem solving in creative playful ways and integrating different media such as robotics, motors, sensors, recyclable materials, arts and crafts, and a tangible programming language. Final KIBO projects that represent a theme found in the overall early childhood curriculum are a wonderful way to engage children in the creative process of learning.

3. ***Collaboration,*** by engaging children in a learning environment that promotes working in teams, sharing resources and caring about each other while working with their KIBO robots. The curriculum utilizes a collaboration web: a tool used to foster collaboration and support. At the beginning of each day of work, each child receives, along with their design journal, a personalized printout with his or her photograph in the center of the page and the photographs and names of all other children in the class arranged in a circle surrounding that central photo (see Appendix B for an example). Throughout the day, with the teacher's prompting, each child draws a line from his or her own photo to the photos of the children with whom he or she has collaborated. Collaboration is defined here as getting or giving help with a project, programming together, lending or borrowing materials, or working together on a common task. At the end of the week, children write or draw "thank you cards" to the children with whom they have collaborated the most.
4. ***Communication,*** through mechanisms that promote a sense of connection between peers or with adults. For example, technology circles, when children stop their work, put their projects on the table or floor, and share their learning process. Technology circles present a good opportunity for problem solving as a community. Some teachers invite all the children sit together in the rug area for this. It can also be helpful to make a "Robot Parking Lot" for all the robots to go while they are not being worked on, so children have empty hands and can focus at the technology circles. Each classroom will have its own routines and expectations around group discussions and circle times, so teachers are encouraged to adapt what already works in their class for the technology circles in this curriculum.
5. ***Community-building,*** through scaffolded opportunities to form a learning community that promotes contribution of ideas. Final projects done by children are shared with the community via an open house, demo day, or exhibition. These open houses provide authentic opportunities for children to share and celebrate the process and tangible products of their learning with family and friends. Each child is given the opportunity not only to run their robot, but to play the role of teacher as they explain to their family how they built, programmed, and worked through problems.
6. ***Choices of conduct,*** which provide children with the opportunity to experiment with "what if" questions and potential consequences, and to provoke examination of values and exploration of character traits while working with robotics. As a program developed following the PTD approach, the focus on learning about robotics is as important as helping children develop an inner compass to guide their actions in a just and responsible way. One way to encourage positive choices is by using "Expert Badges". Children who master concepts quickly can earn Expert Badges (a sticker for them to wear). A child wearing an expert badge uses the remainder of the class period helping any students who are having difficulty with the concepts they have mastered. Children wearing Expert Badges and actively helping others will also have an easier time completing their collaboration webs.

## Classroom Management

Teaching robotics and programming in an early childhood setting requires careful planning and ongoing adjustments when it comes to classroom management issues. These issues are not new to the early childhood teacher, but they may play out differently during robotics activities because of the novelty and behavior of the materials themselves. Issues and solutions other than those described here may arise from classroom to classroom; teachers should find what works in their particular circumstances. In general, provide and teach a clear structure and set of expectations for using materials and for the routines of each part of the lessons (technology circles, clean up time, etc.). Make sure the students understand the goal(s) of each activity. Posters and visual aids can facilitate children's attempts to answer their own questions and recall new information.

### Group Sizes

The curriculum refers to whole-group versus pair or individual work. In fact, some classrooms may benefit from other groupings. Whether individual work is feasible depends on the availability of supplies, which may be limited for a number of reasons. However, an effort should be made to allow students to work in as small groups as possible, even individually. At the same time, the curriculum includes numerous opportunities to promote conversations which are enriched by multiple voices, viewpoints, and experiences. Some classes may be able to have these discussions as a whole group. Other classes may want to break up into smaller groups to allow more children the opportunity to speak and to maintain focus. Some classes structure robotics time to fit into a "center time" in the schedule, in which students rotate through small stations around the room with different activities at each location. This format gives students more access to teachers when they have questions and lets teachers tailor instruction and feedback as well as assess each students' progress more easily than during whole-group work. It is important to find a structure and group size for each of the different activities (instruction, discussions, work on the challenges, and the final project) that meet the needs of the students and teachers in the class.

### Managing Materials

Classroom-scale robotics projects require a lot of parts and materials, and the question of how to manage them brings up several key issues that can support or hinder the success of the unit. The first issue is accessibility of materials. Some teachers may choose to give a complete kit of materials to each child, pair, or table of several children. Children may label the kit with their name(s) and use the same kit for the duration of the curriculum. Other teachers may choose to take apart the kits and have materials sorted by type and place all the materials in a central location. Since different projects require different robotic and programming elements, this set-up may allow children to take only what they need and leave other parts for children who need them. A word of caution, however: If materials are set-up centrally, they must be readily visible and accessible so children don't forget what is available to them or find it too much of a hassle to get what they need. Regardless, it is important to find a clearly visible place to set up materials for demonstrations, posters or visual aids to display for reference, and for robotics and programming materials for each lesson.

The second issue is usability. In some cases, children's desks or tables do not provide enough space to build a robot and program it. Care must be taken to ensure that children have enough space to use the materials available to them. If this is not the case they may tend towards choosing materials that fit the space but not their robotics or programming goal.

Teachers should carefully consider how to address these issues surrounding materials in a way that makes sense for their class's space, routines, and culture. Then, it is crucial to set expectations for how to use and treat materials. These issues are important not only in making the curriculum logistically easier to implement, but also because, as described in the Reggio Emilia tradition, the environment can act as the "third teacher" (Darragh, 2006).

## Student Assessments

Children have fun while working with KIBO and also learn about robots, programming and engineering. At the same time, evaluating the student's learning process and the outcomes is important. This can be done through documenting student's projects and ways of talking about and sharing their projects; and analyzing their Engineering Design Journals. Evaluating individual children's learning, while they are working in groups, can be challenging. The assessment workbook make available through KinderLab Robotics can be useful for this task.

To keep assessment manageable in a busy classroom and also give children a tool to self-regulate their exploration process and self-assess, the assessment criteria given with each lesson can constitute a sequence of concrete achievements leading up to an "Engineer's License." Each lesson is associated with a different level, e.g. "Sturdy Builder" or "Programmer I," that incrementally completes the license, at which point the child is ready to start a final project. During the course of each lesson, children will explore and learn at different rates. When they think they have accomplished the criteria for that lesson's assessments, they demonstrate this to a teacher, who marks that licensure level on their certificate or helps them identify missing components. Children re-attempt any level until they have mastered it. This format allows for individual differences, helps teachers manage the amount of time assessment takes, and provides a fluid way for teachers to assess both individual progress and that of the whole class.

## Academic Frameworks Addressed

This curriculum is designed for early childhood students (pre-kindergarten through second grade) and covers many foundational computer science and engineering skills that are not often taught in early childhood. These academic frameworks are taught through a series of powerful ideas: the engineering design process, robotics, programming, and sensors. Each powerful idea has activities and materials (in this case, the activities are tailored to fit the theme of *Where the Wild Things Are*) that encourage mastery of the powerful idea and the foundational academic subjects that support it. In addition, since robotics provides a powerful way to integrate disciplinary knowledge and skills, the curriculum addresses foundational math, literacy, science, and art skills. Within each lesson in this curriculum, there are descriptions of at least one math and one language arts activity that fit in with the powerful idea being taught. Furthermore, each lesson addresses the Common Core Framework, the ITEEA standards, and the Massachusetts Frameworks.

### Common Core Frameworks Addressed

In addition to teaching basic robotics and programming skills, the activities in this curriculum foster many of the foundational math, reading, and language skills that are commonly taught in early childhood classrooms. See Table 1 below for examples of how the activities in this curriculum are aligned to the U.S. Common Core frameworks. The Common Core framework is "a set of standards that were created to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live" (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

Table 1: Common Core Frameworks

| Curricular Activity | Academic Frameworks Addressed |
|---|---|
| Technology Circle | In technology circle time, children practice their speaking skills as they recount their experiences, share facts, and ask questions about one another's work.<br><br>CCSS.ELA-LITERACY.SL.K.1- Participate in collaborative conversations<br>CCSS.ELA-LITERACY.SL.K.6- Speak audibly and express ideas clearly<br>CCSS.ELA-LITERACY.SL.K.3- Ask & answer questions to get information |
| Engineering Design Journals | Children use their Engineering Design Journals for writing and drawing explanations for their work and answering questions.<br><br>CCSS.ELA-LITERACY.W.K.2- Use a combination of drawing, dictating, and writing<br>CCSS.ELA-LITERACY.L.K.2.D- Spell simple words |
| Building with robotic and non-robotic materials | When building with robotic and non-robotic materials (arts and crafts and recyclables), children grapple with size and shape.<br><br>CCSS.MATH.CONTENT.K.G.B.4- Analyze and compare shapes |
| Programming | When programming, children practice with sequence, order, counting, number sense, and estimation.<br><br>CCSS.MATH.CONTENT.K.CC.A.1- Number names and count sequence<br>CCSS.MATH.CONTENT.K.CC.B.4- Relationship between numbers and quantities<br>CCSS.MATH.CONTENT.K.OA.A.1- Addition and subtraction |

### *ITEEA Standards and MA Frameworks Addressed*

The International Technology and Engineering Educators Association (ITEEA) is a professional organization for technology, design, and engineering educators that promotes technological literacy by supporting the teaching of technology in schools. Table 2 (below) shows how the ITEEA standards line up with the Massachusetts Science and Technology Frameworks and many of the powerful ideas found in this curriculum.

Table 2: ITEEA Standards and MA Frameworks

| Powerful Idea | International Technology and Engineering Educators Association Standards by standard and grade | MA Science and Technology / Engineering (STE) and Technology Literacy (TL) Frameworks by standard and grade |
|---|---|---|
| Engineering design process | - People plan to help get things done. (Std 2E; K-2)<br>- Everyone can design solutions to a problem. (Std 8A; K-2)<br>- Design is a creative process (that leads to useful products and systems). (Std 8B; K-2/Std 8C; Gr 3-5/Std 8E; Gr 6-8)<br>- All designs can be improved. (Std 8F; Gr 6-8) | -Engineering design requires creative thinking and consideration of a variety of ideas (and strategies) to solve practical problems (generated by needs and wants). (STE Std 2 Central Concept; PreK-2 (& Gr 3-5))<br>- Engineering design is an iterative process [...] (STE Std 2 Central Concept; Gr 6-8) |

| | | |
|---|---|---|
| | - The engineering design process includes identifying a problem, looking for ideas, developing solutions, and sharing solutions with others. (Std 9A; K-2)<br>- Asking questions and making observations helps a person to figure out how things work. (Std 10A; K-2)<br>- Troubleshooting is a way of finding out why something does not work so it can be fixed. (Std 10C; Gr 3-5) | |
| Robotics | -Build or construct an object using the design process. (Std 11B; K-2)<br>-Discover how things work. (Std 12A; K-2)<br>-Systems have parts that work together to accomplish a goal (Std 2B; K-2)<br>-Tools, machines, etc. use energy to do work. (Std 16D; Gr 3-5) | - With teacher direction, use appropriate technology tools [… ] to define problems and propose hypotheses. (TL Std 3.6; Gr 3-5)<br>-Describe the various ways that objects can move, such as in a straight line, zigzag, back-and-forth, round-and-round, fast, and slow. (STE Physics Std 3; K-2) |
| Programming: Control Flow by Sequencing and Instructions | Recognize and use everyday symbols (Std 12C; K-2)<br>-People use symbols when they communicate by technology (Std 17C; K-2)<br>-The study of technology uses many of the same ideas and skills as other subjects. (Std 3A; K-2) | -Identify and explain how symbols and icons [… ] are used to communicate a message (STE Tech Std 3.4; Gr 6-8) |
| Sensors | -The natural world and human-made world are different. (Std 1A; K-2) | -Characteristics of natural and human-made materials (STE Tech Std 1.1; PreK-2)<br>-Human beings use parts of the body as tools (STE Tech Std 2.2; PreK-2) |

### Integrating Literacy with Programming & Robotics

The *Where the Wild Things Are* curriculum integrates foundational concepts of literacy with powerful ideas from programming and robotics. While the *Where the Wild Things Are* curriculum includes activities that focus specifically on this theme, the robotics piece can be modified to fit in with numerous other early childhood content areas. In addition to the math and language arts connections found in each lesson, you will also find a literacy connection that draws directly from the book *Where the Wild Things are*. The literacy connections (see Table 3) are derived to meet the Massachusetts DOE Frameworks for English Language Arts and Literacy for K- 2$^{nd}$ grade. This curriculum contains activities that specifically address the following literacy frameworks: recalling details about the settings and characters in a story, retelling a sequence of events, recognizing repeating words and phrases in a story, and describing feelings.

Table 3: Literacy Connections within the *Where the Wild Things Are* Curriculum

| **Lesson** | **Literacy Connection:** | **Literacy Activities:** |
|---|---|---|
| Lesson 1: Sturdy Building | Recalling details from the story | Children hear the story *Where the Wild Things Are*. They are asked to pay close attention to the pictures and words, especially regarding how Max travels from his room to where the wild things are. Children will create their own non-robotic version of Max's boat. |
| Lesson 2: What is a Robot? | Describe characters in the story | Children will work as a class to create a chart with descriptions of how Max and the wild things look. Children will use these descriptions to make Max or one of the wild things as decorations for their KIBO robot. |
| Lesson 3: What is a Program? | Retelling a sequence of events from a story | Children will talk about the different events in the story and how they came in a specific order. If Max had not made mischief, would he have ended up where the wild things are? What if Max had smelled supper before the wild rumpus happened-would it have changed the story? After programming their "Max" robots to dance the Hokey-Pokey, children will be encouraged to think about other songs that have a specific order. |
| Lesson 4: What are Sensors? (Part 1) | Recalling how Max used his five senses throughout the story | Children will recall Max's experience at home and where the wild things live. What did Max smell, touch, taste, hear, and see? |
| Lesson 5: What are Repeats? | Recognize repeating words and phrases in the story | Children will recall the words or phrases (such as "terribly" and "they roared their terrible roars") that repeat in the *Where the Wild Things Are* book. |
| Lesson 6: What are Sensors? (Part 2) | Recalling how the wild things used their five senses throughout the story | Children will recall how the wild things sensed their environment. What did they smell, touch, taste, hear, and see? |
| Lesson 7: What are Ifs? | Understanding characters' feelings | Children will talk about how Max may have felt when he yelled at his mother. What would have happened if Max hadn't felt wild and yelled? Children will create their own drawings and finish the statement "If I feel wild, I _____." This can also be with other If statements, such as "If I feel angry" or "If I feel happy." |

# Lesson 1: Sturdy Building

*Powerful Idea: The Engineering Design Process*

## *Overview:*

Children use crafts and recycled materials to build a non-robotic boat that can transport a toy person, just like Max's boat in *Where the Wild Things Are*. The powerful idea in Lesson 1 (building sturdily through the use of the engineering design process) will prove important to the success of the children's robots in subsequent lessons and should be rearticulated and discussed during each activity.

| ***Prior Knowledge*** | ***Objectives*** | |
|---|---|---|
| | *Students will understand that…* | *Students will be able to…* |
| • None, but prior experience building with arts and crafts or recycled materials is helpful. | • Craft and recycled materials can fit together to form ***sturdy structures***.<br>• The ***engineering design process*** is useful for planning and guiding the creation of artifacts.<br>• There are many different kinds of engineers. | • Build sturdy, non-robotic vehicles.<br>• Use the engineering design process to facilitate the creation of their vehicles. |

## *Materials / resources:*

- *Where the Wild Things Are* by Maurice Sendak
- A variety of crafts and recycled materials for building and decorating
- Engineering Design Process poster*
- Engineering Design Journals*
- Pictures of naturally occurring and manmade object
- Pictures of different vehicles
- Expert badges*
- Collaboration Webs (one per child)

*can be purchased through KinderLab Robotics, Inc.

## *Lesson 1 Vocabulary:*

***Circle*** – a round shape with no edges
***Cycle*** – something that moves in a circle (i.e. the seasons, the Engineering Design Process)
***Design*** – a plan for a building or invention
***Edge*** – the border of a shape
***Engineer*** – someone who invents or improves things
***Material*** – something used to build or construct
***Rectangle*** – a shape with four sides, two pairs of sides with equal length
***Structure*** – a building or object made with different parts
***Square*** – a shape with four equal sides
***Triangle –*** a shape with three sides

## *Activity description*

### Paying Attention to Details in *Where the Wild Things Are*

Prior to this lesson, read the book *Where the Wild Things Are* to students. While reading the book, ask students to pay close attention to the pictures and words, especially regarding how Max travels from his room to where the wild things are. Later in this lesson, children will create their own non-robotic version of Max's boat.

### Shapes of the Boat (5-10 min)

Ask children to draw a boat in their Engineering Design Journals, and to identify different shapes they see making up the boat. As a class, make a big list of all the different shapes they noticed. Then, look at craft and recycled materials and ask children to identify the shapes they see and make another list. Compare the two lists as a class. What shapes do they have in common? How can we use materials in the classroom to build boats that look like the real ones? In this activity, children will work to identify and describe 2d shapes and practice comparing and contrasting.

### *Introduce the concepts and the task (10 min)*

"Today we will be building boats, and we're going to use a tool to help us make sure our structures are sturdy and work the way they are supposed to." Discuss what an engineer is and introduce the steps of the engineering design process.

## *All about Engineers!*

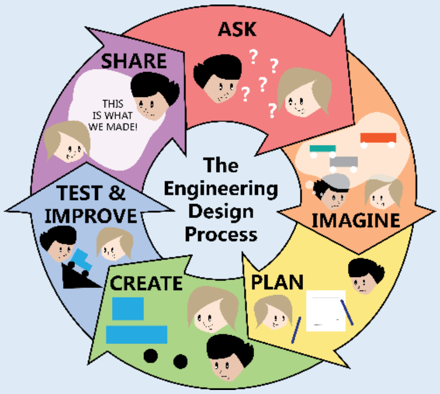
*An engineer is anyone who invents or improves things (for instance, just about any object you see around you) or processes (such as methods) to solve problems or meet needs. Any human-made object you encounter in your daily life was influenced by engineers.*

There are many different kinds of engineers including: biomedical engineers, aerospace engineers, computer engineers, and industrial engineers. For descriptions and further activity ideas, check out: http://www.eweek.org/AboutEngineering/TypesEngineering.aspx and Engineering is Elementary from the Boston Museum of Science resources at http://www.eie.org/eie-curriculum/curriculum-units. Discuss as a class what these different kinds of engineers make and do.

**Book Suggestion**

*Engineering the ABC's,* by Patty O'Brien Novak, answers questions about how everyday things work and how engineering relates to so many parts of a child's daily life. In an entertaining way, this book shows how engineers shape our world.

## Engineering Design Process




When making projects, engineers follow a series of steps called the "Engineering Design Process." It has just 5 steps: ASK, IMAGINE, PLAN, CREATE, TEST & IMPROVE, and SHARE. The Engineering Design Process is a cycle – there's no official starting or ending point. You can begin at any step, move back and forth between steps, or repeat the cycle over and over!

**Engineering Design Process song**
(to the tune of "Twinkle, Twinkle")
Ask and imagine, plan and create,
Test and improve and share what we make. (Repeat)

### Jump for Engineers (5-10 min)

Look at a series of pictures of naturally occurring and manmade objects. Student should jump if they think an engineer built them and stay seated if they think otherwise. Discuss reasoning. Some examples of pictures might be bridges, dogs, medicine, computers, and food.

### Think Like an Engineer (5 min)

Everyone in the class is going to start thinking like an engineer! That means looking at the purpose of objects and how they function. What are the different parts that make up the whole? What do they do? Why are they important? Show pictures of some different vehicles and boats and ask these engineer's questions.
Ex 1: Fire engine- What are the different parts of the fire engine? What function does each part have? Why is each part important?
Ex.2: Ice Cream truck- What function does each part have? What parts are the same as the fire engine? What parts are different? Why?

### Individual/ Pair Work (20-25 min)

Students follow the steps of the engineering design process and use crafts and recycled materials to create a boat, either like the one that Max sailed on in the story or one that students make up. They may use both structural and aesthetic materials. Students then decorate their non-robotic boats. Students should demonstrate to a teacher that their structures meet the following criteria when they are ready.

- It is sturdy and remains intact when picked up or moved around
- It is designed to resemble a boat
- It has a place for the toy person to ride

*Note: Working Individually vs. Working in Pairs*

Whether students work in pairs versus individually throughout this lesson is left up to the teachers' discretion based on several factors. Materials may be limited, making pair work necessary. Teachers may also have goals for children's social development that an explicit focus on sharing and teamwork throughout this curriculum can support. On the other hand, teamwork can be challenging at this age, so students may benefit from having their own materials and the option rather than the requirement to collaborate with others when it makes sense.

### Postcard Home (5-10 min)

Children will recall the day's activities. They will try to remember the vehicles and boats they saw, the shapes they noticed, and what they liked the most. Children will fill out a blank postcard (in their Engineering Design Journals) where they will draw pictures describing their day for them to send home to their families. With help, they can try to label their pictures using vocabulary words (or dictate the words for the teacher to label). When postcards are complete, cut them out so that children can mail them or take them home.

### Expert Badges

Children who finish building their boats and master all concepts quickly get to wear a badge that says "Engineering Expert." Engineering Experts walk around and offer help to any classmates experiencing difficulties.

### Collaboration *Web*

As children progress through the lesson, they will complete their collaboration webs. They will draw lines from their picture to the pictures of any classmates who give them help. If children say they didn't receive any help, remind them to think of their partners, class Experts, or if they got any ideas by looking at another classmate's project.

### Technology Circle (10 min)

After finishing, students share their creations. They may do one or more of the following: explain the features of their creation, describe the features of their final design that make it sturdy, talk about what they found easy and difficult, and/or share anything they changed from their original plan. They may also want to share their postcards or their collaboration webs.

### Free-play (10-20 min)

Provide opportunities for children to build freely with craft and recycled materials. Encourage them to make sturdy structures. Can they make a structure that will stay together if it is dropped from ankle height? What about waist height?

# Lesson 2: What Is a Robot?

*Powerful Idea: Robots have Special Parts to Follow Instructions*

## *Overview:*

Children share ideas and learn about what robots are. Children then build their own robotic vehicles and decorate them as Max or one of the wild things. The powerful idea in Lesson 2 (robots have special parts to let them follow instructions) will prove important to the success of the children's robots in subsequent lessons.

| ***Prior Knowledge*** | ***Objectives*** | |
|---|---|---|
| | *Students will understand that…* | *Students will be able to…* |
| • Craft and recycled materials can fit together to form sturdy structures.<br>• The **engineering design process** is useful for planning and guiding the creation of structures.<br>• Symbols (pictures, icons, words, etc.) can represent ideas or things.<br>• Some ability to recognize letters or to read is helpful, but not required. | • **Robots** need moving parts, such as motors, to be able to perform behaviors specified by a **program**.<br>• The robotic 'brain' has the programmed instructions that make the robot perform its behaviors. | • Describe the components of a KIBO robot.<br>• Scan a program onto the KIBO robot using the wooden blocks.<br>• Build sturdy, robotic vehicles that move. |

## *Materials / resources:*

- Pictures of different robots and non-robots
- One KIBO kit for each student/pair*
- A variety of craft and recycled materials for building and decorating
- Engineering Design Journals*
- KIBO Parts Poster*
- Expert badges*
- Collaboration webs (one per child)

## *Lesson 2 Vocabulary:*

***Automatic* –** by itself, without help from a person
***Function*** – the reason a machine or robot was built
**Main board** – the robot's 'brain'
***Motor*** – the part of a robot that makes it move
***Robot*** – a machine that can be programmed to do different things
***Wheels*** – the round parts of a vehicle that turn in circles and allow it to move
***Wires*** – the long, skinny tubes that connect all the robot's parts

# *Activity description*

### Describing Max and the Wild Things

What do Max and the wild things look like? How are they alike and how are they different? As a class, create a chart to display to describe how Max and the wild things look. The chart can use a combination of words and pictures. Later in this lesson, children will use these descriptions to make Max or one of the wild things as decorations for their KIBO robot.

### Jump for Robots (5-10 min)

Show a variety of different pictures of robots and non-robots such as computers, cars, animals, foods, and famous robots such as Wall-E and R2D2. Additionally, it may be helpful to show toy robots (i.e. plush toys) and discuss how something can look like a robot or machine on the outside but not have any actual mechanical parts. To play this game, children jump up and down if they think the picture shown is of a robot. They stay standing still if they think it is not a robot. Later, make an "Is It a Robot?" chart putting these images in one of three categories: Robots, Maybe Robots, and Not Robots.

### Graphing Class Responses (10 min)

Students jump (or make another movement) for statements they think are true and sit down for statements they think are false. As you go along, make a chart with True and False for each question along the horizontal axis and number of students along the vertical axis. Have students place a marker (sticker, symbol, etc.) in the "True" or "False" column. As a class, children will be able to read the graph in order to see whether there were more "True" or "False" responses for each question.

1. *Robots are machines (TRUE).*
2. *All robots are made of the same materials (FALSE).*
3. *Robots must have moving parts (TRUE).*
4. *Robots can think by themselves (FALSE).*
5. *All robots look alike (FALSE).*
6. *Robots must be able to move around the room (FALSE).*
7. *Robots are operated using remote controls (FALSE).*
8. *People tell robots how to behave with a list of instructions called a program (TRUE).*
9. *Some robots can tell what is going on around them (TRUE).*
   *(Examples: sensing light, temperature, sound, or a touch.)*
10. *Robots are alive (FALSE).*

### Introduce the concepts and the task (10-15 min)

"Today we will be talking about what a robot is and learning about how to put the KIBO robot together. " As a class, children discuss what they think a robot is and examples of robots they know of. Talk about the "Is it a Robot?" chart and define the characteristics of robots. It may be helpful to watch video clips of different types of robots in action such as home robots, space robots, factory robots, hospital robots, and child-made robots. Then, show a KIBO robot and introduces the robot's key part and their functions with the help of the KIBO Parts poster. Finally, teach the Robot Parts Song and have students sing and dance along.

## *Parts of the KIBO Robot*

Body

Wheels

Motor

Light Output

Sound Sensor

Light Sensor

Distance Sensor

## *The Robot Parts Song*

(to the tune of "Dry Bones")
The wheels are connected to the motors,
The motors are connected to the body,
The engineers give it a program,
So move, robot, move!

### Individual/ Pair Work (20-25 min)

Students work individually or in pairs to put the KIBO robot together. When attaching the different parts, they should make sure that the parts are attached sturdily and that they will not fall off. Also, students should experiment with putting two motors and two wheels on the side to create a vehicle, or putting one motor on top to create a kinetic sculpture. Once students have assembled KIBO, they should create a Max or wild thing character out of crafts and recyclables and attached the decorations to their robots. When they think they have a working and decorated robot, students should bring it to a testing station where they upload the program "Begin, Forward, End" and run it. This test is to ensure that their robot follows the instruction properly and that it is sturdy. Teachers can help make sure the robots' motors are properly oriented so that the motors turn as expected to make the robot go forward.

*Note: Establishing Rules*

It is important to establish rules and expectations as to how students treat each other's materials, programs, and robots. Find a time for students to generate these group expectations. Students may be better able to imagine reasonable expectations after using the robots or programming interface once.

### How-To Guide (5-10 min)

In the Engineering Design Journals, have students explain how to put together the KIBO robot by creating a series of drawings showing all the different robotic and non-robotic parts they used. Encourage students to use the new vocabulary words that they've learned to label the different parts, or have them dictate to a teacher who can write the labels.

### Expert Badges

Children who finish building their vehicles and master all concepts quickly get to wear a badge that says "Robotics Expert." Robotics Experts walk around and offer help to any classmates experiencing difficulties.

### Collaboration *Web*

As children progress through the lesson, they will complete their collaboration webs. They will draw lines from their picture to the pictures of any classmates who give them help. If children say they didn't receive any help, remind them to think of their partners, class Experts, or if they got any ideas by looking at another classmate's project.

### Technology Circle (10 min)

Have the students share their creations with the rest of the class (or a small group). During this time, students can share the parts and features of their robot, share what they found easy or difficult, or share what makes their robot sturdy. What do they think will happen if they make a robot that is missing one of its pieces? Try it out!

### Free-play (10-20 min)

Provide opportunities for children to build freely with KIBO parts and other building materials.

# Lesson 3: What is Programming?

*Powerful Idea: Control Flow by Sequencing and Instructions*

## *Overview:*

For this lesson, students choose the appropriate instructions and learn the importance of sequence as they program their Max or wild things robots to dance the Hokey-Pokey. This activity can be done with many other children's songs. If you wish, think of other songs and how to program a robot to dance to the words. Be creative (the children will be)!

| ***Prior Knowledge*** | ***Objectives*** | |
|---|---|---|
| | *Students will understand that…* | *Students will be able to…* |
| • Symbols (pictures, icons, words, etc.) can represent ideas or things.<br>• A robot is a machine that can act on its own once it receives proper instructions.<br>• KIBO robots have special parts (i.e. motors, wheels, and a "brain"). | • Each block corresponds to a specific instruction.<br>• A **program** is a sequence of instructions that is followed by a robot.<br>• The order of the blocks dictates the order in which the robot executes the instructions. | • Point out or select the appropriate block corresponding to a planned robot action.<br>• Connect a series of blocks by fitting the pegs of one block into the hole of the following block.<br>• Scan a completed program onto the KIBO robot<br>• Fix the sequence if they see it doesn't work (debugging). |

## *Materials / resources:*

- One KIBO kit for each student/pair with decorations from Lesson 2
- KIBO Says game*
- KIBO programming blocks*
- Engineering Design Journals for planning*
- Collaboration webs (one per child)

## *Lesson 3 Vocabulary:*

***Barcode***– a pattern of lines that are readable by machines like the KIBO robot
***Instruction*** – a direction that a robot will listen to
***Order*** – parts of a group arranged to make sense
***Program*** – a set of instructions for a robot
***Scanner***– electronic device for reading printed barcodes
***Sequence*** – the order of instructions that a robot will follow exactly

# *Activity description*

### Order Matters

Children will talk about the different events in the story and how they came in a specific order. If Max had not made mischief, would he have ended up where the wild things are? What if Max had smelled supper before the wild rumpus happened-would it have changed the story? After programming their "Max or wild thing robots to dance the Hokey-Pokey, children will be encouraged to think about other songs that have a specific order.

### KIBO Says (5-10 min)

This activity is played like the traditional "Simon Says" game in which students repeat an action if Simon says to do something. After briefly introducing each programming instruction and what it means, have the class stand up for this game. Hold up one big KIBO icon at a time and say "Programmer says to _________". Go through each individual instruction a few times until the class seems to get it. Once the class is familiar with each instruction, the Programmer can start giving the class full programs to run through. Just like in the real Simon Says, the Programmer can try to be tricky! For example, if the Programmer forgets to give a Begin or End instruction, should the class still move?

### Introduce the concepts and the task (10 min)

"Today we will give instructions, or programs, to our robots so they will do the Hokey-Pokey." The whole class sings and dances the Hokey Pokey to make sure everyone remembers it. Conclude with a "robot verse":

*You put your robot in, you put your robot out,*
*You put your robot in, and you shake it all about.*
*You do the Hokey Pokey, and you turn yourself around.*
*And that's what it's all about. (Clap, clap.)*

Show the different actions, or programming instructions, that KIBO can do. For this lesson, it is helpful to only show the Begin block, End block, blue (action) blocks, and orange (sound) blocks. Emphasize that every program must start with a Begin and finish with an End. Then, demonstrate how to connect the blocks and scan a program onto KIBO. Create a demo program to show the class.

## *What is a Program?*

*A program is a sequence of instructions that the robot acts out in order. Each instruction has a specific meaning, and the order of the instructions affects the robot's overall actions.*

### Program the Teacher (5-10 min)

Using the KIBO Says game, children will work as a class to "program" their teacher to move from one part of the room to the other. Be silly! An example would be for the children to "program" their teacher to move from the front of the room to the library area by using the blocks "Begin," "Forward," "Forward," Turn Left," "Forward," and "End." The goal of this game is for students to practice sequencing as a class before working individually or in their small groups. Before the teacher-robot moves, children can make predictions about where the teacher-robot will end up. It may be helpful to let the children make mistakes in order to foster a discussion on problem-solving and sequencing.

### Individual/ Pair Work (20-25 min)

Individually or in groups, students program their KIBOs (built and decorated in Lesson 2) to do the Hokey Pokey. When all groups are done, everyone does the Hokey Pokey with the robots! As an extension, children can think of other songs with specific orders, and create a program for it.

### Counting and Sequencing (5 min)

How many times did students use each programming block? What order did they put their blocks in? Children will keep track of the number of forward, backward, spin, shake, beep, and sing blocks they use for their Hokey Pokey programs. Did the whole class use the same number of each block?

### Programming Charade (5-10 min)

Students will pair up. One child will make up a program using the KIBO blocks and act it out while the other partner guesses what the programming instructions are. Have student switch roles. Then, have them work together to come up with a program that they will "write" out (using stickers or cutouts of the KIBO blocks) to act out for the class.

### Expert Badges

Children who finish early get to wear a badge that says "Programming Expert." Programming Experts walk around and offer help to any classmates experiencing difficulties programming.

### Collaboration *Web*

As children progress through the lesson, they will complete their collaboration webs. They will draw lines from their picture to the pictures of any classmates who give them help. If children say they didn't receive any help, remind them to think of their partners, class Experts, or if they got any ideas by looking at another classmate's project.

### Technology Circle (10 min)

Students share their creations. They may do one or more of the following: explain the blocks they used for their program, talk about what they found easy and difficult, and share anything they changed from their original plan. If desired, video-record the class dancing the Hokey-Pokey with their robots to make a "music video" to send home to parents!

### Free-play (10-20 min)

Provide opportunities for children to play with scanning different blocks and seeing what happens. As students are ready, prompt them to plan ahead about what they want the robot to do.

# Lesson 4: What are Sensors? (Part 1)

*Powerful Idea: Sensors*

## *Overview:*

Students will learn about sensors and program their robots to sing and dance to the "If You're Happy and You Know It" song. Students will learn specifically about the sound sensor and the Wait for Clap block in this lesson. In Lesson 6, students will learn about the distance and light sensors.

| ***Prior Knowledge*** | ***Objectives*** | |
|---|---|---|
| | *Students will understand that…* | *Students will be able to…* |
| • Understand that humans and animals have **sense** organs.<br>• Understand that people and animals use information provided by their **senses** to help make decisions.<br>• A robot is a machine that can act on its own once it receives proper instructions.<br>• KIBO robots scan blocks to learn a program<br>• Arranging and scanning blocks in a different order will result in a different program. | • A robot can **sense** its surroundings with a sensor.<br>• There are different kind of **sensors.** | • To use a sound **sensor** with KIBO.<br>• To program with the Wait For Clap Block.<br>• Compare and contrast human **sense** and robot **sensors.** |

## *Materials / resources:*

- One KIBO kit for each student/pair*
- KIBO Parts Bingo boards* (one per student) and plastic chips
- KIBO programming blocks*
- K IBO Sound Sensor
- Engineering Design Journals*
- Expert Badges*
- Collaboration Webs

## *Lesson 4 Vocabulary:*

***Senses*** – The way humans and animals take in information about the surrounding environment. Humans have five senses- touch, taste, smell, sight, and hearing.

***Sensor*** – a special part that helps machine take in information about the surrounding environment; there are sensors are very much like human senses.

# *Activity description*

### What did Max Sense?

Throughout *Where the Wild Things Are*, Max uses his five senses. Reread the story and keep track of the different ways that Max uses his senses. What did he taste, smell, touch, hear, and see? Ask children what they think they would have sensed if they were Max and they were visiting where the wild things are.

### KIBO Parts Bingo (10 min)

Review the different parts of KIBO by playing KIBO Parts Bingo. Give each student one BINGO board and some plastic chips.  Have each student place one chip on the “free space.” Then, hold up one piece of KIBO at a time. Each student should find the picture of that piece on their BINGO board and cover it with a chip. Play until one student shouts “KIBO,” which is when they have four pictures in a row covered.

### Sensor Walk (10-15 min)

Divide the class into two groups: Humans and Robots. Take the class for a walk around the school or neighborhood. As a class, keep a list of all the different things the humans and robots can sense and what part they used to sense it. For example, the human group may sense the sunlight with their eyes while students in the robot group would sense this with their light sensors. Children in the robot group do not need to be limited to KIBO sensors, but can think creatively about all kinds of sensors a robot might have. Upon returning to the classroom, compare and contrast the Human and Robot lists. Are there some things humans can sense but robots cannot? What about vice versa?

### Introduce the concepts and the task (10-15 min)

Discuss examples of human senses and how these senses let us gather information about what’s going on around us, so that we can make decisions based on this information. Then explain to students that they need programming instructions to tell the robot what to do with the information from its sensors. Show the Wait for Clap block and create an example program together. Run the program, and have students discuss what the robot is doing.  Then, show the distance and light sensors. Explain that these sensors are programmed with using different blocks (Repeat and End Repeat, and If and End If blocks). Explain that they will get to experiment with the other two sensors in a later lesson.

## *What is the Sound Sensor?*

KIBO’s Sound Sensor can hear sounds, just like ears can.  It is programmed using the Wait for Clap block.

## Individual/ Pair Work (20-25 min)

The students add a sound sensor to their robots and program them to dance a version of the song "If You're Happy and You Know It." In the story *Where the Wild Things* Are, Max acts wild. Children program their robots to move in any way during the lyrics "If your wild and you know it" and then wait until the robot hears a clap (representing the lyrics "Clap your Hands"). Students then select their favorite instructions to show that their robot is acting wild. Students can choose as few or as many blocks as they would like to put after the "Wait for Clap" block.

## Sensors in the World (5-10 min)

As a class, think about sensors that are in our everyday lives. Make a list of all the sensors the class can think of in the following places: bathroom, office building, classroom, and public transportation. Feel free to add another own category in addition to these suggestions. Then, count how many sensors that the class identified in each place, and compare. Why might one place have more sensors than another? Teachers can create a graph to represent the results if they'd like.

## Expert Badges

Children who finish mastering all concepts quickly get to wear a badge that says "Sensor Expert." Sensor Experts walk around and offer help troubleshooting to any classmates experiencing difficulties attaching their sensors or programming with sensors.

## Collaboration *Web*

As children progress through the lesson, they will complete their collaboration webs. They will draw lines from their picture to the pictures of any classmates who give them help. If children say they didn't receive any help, remind them to think of their partners, class Experts, or if they got any ideas by looking at another classmate's project.

## Technology Circle (10 min)

Students share their programs. They may do one or more of the following: show their programming blocks and point out where they decided to add the Wait for Clap block, demonstrate different ways to trigger the sound sensor (clapping, talking, etc.), and share things that were difficult to figure out.

## Free-play (10-20 min)

Provide opportunities for children to experiment with the Wait for Clap block and the sound sensor. What happens when the sound sensor isn't attached? What about if nothing is placed after the Wait For Clap block?

# Lesson 5: What are Repeats?

*Powerful Idea: Repeats (Loops and Numbers)*

## *Overview:*

Students will learn about a new instruction that makes the robot repeat programming instructions infinitely or a given number of times. They use these new instructions to program their Max robots to travel along different routes from Max's room to where the wild things are.

<table>
<tr><th rowspan="2">Prior Knowledge</th><th colspan="2">Objectives</th></tr>
<tr><th>Students will understand that…</th><th>Students will be able to…</th></tr>
<tr><td><ul><li>A robot is a machine that can act on its own once it receives proper instructions.</li><li>KIBO robots have modules.</li><li>KIBO robots scan blocks to learn a program.</li><li>Arranging the same blocks in a different order will result in a different program.</li></ul></td><td><ul><li>An instruction or sequence of instructions may be modified to repeat.</li><li>Some programming instructions, like 'Repeat,' can be qualified with additional information.</li></ul></td><td><ul><li>Recognize a situation that requires a looped program.</li><li>Make a program that loops.</li><li>Use number parameters to modify the number of times a loop runs.</li></ul></td></tr>
</table>

## *Materials / resources:*

- One KIBO kit for each student/pair
- KIBO Says game*
- KIBO programming blocks and parameters
- Engineering Design Journals*
- Non-robotics building material
- Masking tape, to create different shaped path
- Index cards and markers (optional, to make destination cards)

## *Lesson 5 Vocabulary:*

***Loop*** – something that repeats over and over again
***Parameter*** – a limit that a robot will follow
***Pattern*** – a design or sequence that repeats
***Repeat*** – to do something more than once

## *Activity description*

### Repeating In *Where The Wild Things Are*

Throughout the book *Where the Wild Things Are*, certain phrases and words are repeated multiple times. Reread the book as a class and come up with a list of what phrases or words are repeated. Why might the author have done that?

### KIBO Says or Program the Teacher (5-10 min)

Play "KIBO Says" or "Program the Teacher" (see Lesson 3 for instructions) for students to practice recognizing the KIBO programming icons and creating programs.

### Patterns & Counting (5 min)

After showing a robot acting out a sample program that is a pattern, children will identify the repeating unit, count how many times it repeats, and (as a class) change the program so that it uses a repeat to accomplish the same outcome.

### Introduce the concepts and the task (10-15 min)

Introduce the Repeat and End Repeat blocks. What does it mean to repeat something? Make a model repeating program to demonstrate the proper syntax. Emphasize that the robot only repeats the instructions in between the Repeat and the End Repeat blocks. Scan the following program to a KIBO robot and run it: Begin, Repeat Forever, Forward, End Repeat, End. Notice how the robot will not stop unless you press the button (to stop it). Introduce the Number Parameters ("Numbers") and model how to add them to the repeating program so that it loops the given number of times before stopping. As a class, create and scan several sample Repeat Loop programs and see what the KIBO does! Make sure to try a few syntactically *incorrect* programs too!

## *What is a Repeat Loop?*

*Repeat and End Repeat are like the bread of a sandwich. The programming blocks put inside of them are like the filling. KIBO will only repeat commands that are placed inside of the Repeat Loop sandwich. Segments of the code placed outside of the sandwich will not be repeated.*


### Individual/ Pair Work (20-25 min)

Students explore a situation in which some but not all the instructions need to be repeated. The students program their Max robotics to drive from home to where the wild things are along different shaped paths, making the robot stop when it arrives. Some examples of shapes to create using masking tape are straight, "L" shaped, and square roads. Set up several roads, perhaps of different lengths, with one leg of each road being at least 2-3 "Forwards" long. It may be helpful to create destination cards out of index cards which show Max's room and the island of the wild things.

*Note: Adapting the Challenge*

Break the challenge into parts: first have students program their robots to drive along one part of their road before adding the turn and the second leg of the journey. Such adjustments can make a big difference for some students as using Repeats can be complex.

### Toothbrush Exercise (5-10 min)

Have students think about the way they brush their teeth as a task that requires some repeating motions (like moving the toothbrush from left to right) and other motions that only happen once (like squeezing out toothpaste). Working in pairs, have students pretend that they are a robot that needs a program to brush their teeth. Using programming instructions (and made up instructions like "spit" and "rinse"), have them make up a program that uses repeats and act it out for a partner. Did they have the same program or different programs?

### Expert Badges

Children who finish mastering all concepts quickly get to wear a badge that says "Repeat Expert." Repeat Experts walk around and offer help troubleshooting to any classmates experiencing difficulties programming with repeats.

### Collaboration *Web*

As children progress through the lesson, they will complete their collaboration webs. They will draw lines from their picture to the pictures of any classmates who give them help. If children say they didn't receive any help, remind them to think of their partners, class Experts, or if they got any ideas by looking at another classmate's project.

### Technology Circle (10 min)

Students share their programs and discuss how Repeats work, especially how order is important.

### Free-play (10-20 min)

Students need time to explore the new instructions. They should build programs that use (or don't use) them. In doing so, they will gain comfort with sequencing the blocks correctly, how the robot follows instructions before, between, or after the Repeat and End Repeat blocks, and when Repeats are helpful to use.

# Lesson 6: What are Sensors? (Part 2)

*Powerful Idea: Sensors*

## *Overview:*

Students will learn about the distance and light sensors and program their robot to travel along different roads using one of the sensors and the Repeat and End Repeat blocks.

| ***Prior Knowledge*** | ***Objectives*** | |
|---|---|---|
| | *Students will understand that…* | *Students will be able to…* |
| • Understand that humans and animals have **sense** organs.<br>• Understand that people and animals use information provided by their **senses** to help make decisions.<br>• A robot is a machine that can act on its own once it receives proper instructions.<br>• KIBO robots scan blocks to learn a program<br>• Arranging and scanning blocks in a different order will result in a different program. | • A robot can **sense** its surroundings with a sensor.<br>• There are different kind of **sensors.**<br>• A robot can react to collected data by changing its behavior.<br>• Certain instructions (like "Repeat") can be modified with **sensor** data. | • To use a distance and light **sensor** with KIBO.<br>• Compare and contrast human **senses** and robot **sensors.** |

## *Materials / resources:*

- *My Five Senses* book by Aliki
- One KIBO kit for each student/pair*
- KIBO Blocks Bingo boards* (one per student) and plastic chips
- KIBO programming blocks*
- K IBO Distance and Light Sensors
- ruler
- Engineering Design Journals*
- Expert Badges*
- Collaboration Webs

### *Lesson 6 Vocabulary:*

***Senses*** – The way humans and animals take in information about the surrounding environment. Humans have five senses- touch, taste, smell, sight, and hearing.

***Sensor*** – a special part that helps machine take in information about the surrounding environment; there are sensors are very much like human senses.

# *Activity description*

## What Did the Wild Things Sense?

Throughout *Where the Wild Things Are*, the wild things use their five senses. What did they smell, touch, taste, hear, and see? Record the class' responses. How is this list similar or different to how Max used his senses? It may be helpful to refer back to the activity "What Did Max Sense? in Lesson 4.

## KIBO Blocks Bingo (10 min)

Review the different blocks that KIBO can be programmed with by playing KIBO Blocks Bingo. Give each student one BINGO board and some plastic chips. Have each student place one chip on the "free space." Then, hold up one programming block at a time. Each student should find the picture of that block on their BINGO board and cover it with a chip. Play until one student shouts "KIBO," which is when they have four pictures in a row covered.

## *My Five Senses* (10-15 min)

Read the story *My Five Senses* by Aliki and have a discussion about when students might use each of their five senses. Then, in their Engineering Design Journals, have students chose one of the five senses and draw a picture of a situation in which they would use that sense. With help, they can try to use words to describe the situations (or dictate the words for the teacher to write).

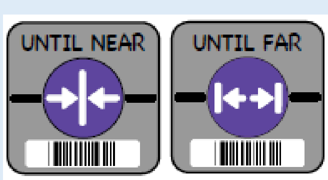
## Introduce the concepts and the task (10-15 min)

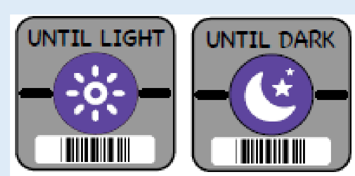
Review examples of human senses and how these senses let us gather information about what's going on around us, so that we can make decisions based on this information. Explain to students that we need special programming instructions to tell the robot what to do with the information from its sensors. Show the Repeat and End Repeat blocks, which are now familiar, and the new Until Near/ Until Far and the Until Light/Until Dark parameter cards. Create two example programs together, one which uses the distance sensor and one which uses the light sensor. Run the program, and have students discuss what the robot is doing.

## *What are the Distance and Light Sensors?*

KIBO uses the Distance Sensor to see how near or far KIBO is from other objects. With Distance Parameters, the Distance Sensor can be used with Repeat Loops to control how KIBO moves.

KIBO's Light Sensor can detect light in the room around it. If a flashlight is shining on KIBO, the light sensor will tell KIBO it is "bright." If there are no lights shining on KIBO, the light sensor will tell KIBO it is "dark."



## Individual/ Pair Work (20-25 min)

Students create programs using the distance or light sensor for their Max robots to travel along different paths from Max's house to where the wild things are. Place masking tape in different shapes (such as a straight line, "L" shape, and square) along the floor to create different paths for the KIBO robot. Students should choose one of the sensors (distance or light) and program it using the Repeat and End Repeat blocks, as well as the appropriate parameter, to stop at the end of each path. It may be helpful for students to start with the straight line path before moving onto a more complex path.

## How Close? (5-10 min)

As a class, experiment with how close someone must be in order for the robot to sense its surrounding. Scan the following program onto a robot: Begin, Repeat Until Near, Shake, End Repeat, End. Start with the distance sensor and invite one student to be the tester and one student to be the measurer. Have the measurer take a ruler and measure 12 inches away from the robot. Then, after the robot's program has started, have the tester position his or her hand at that mark and slowly move his or her hand closer to the distance sensor. When the robot stops shaking, have the measurer determine the distance that the hand must be in order for the robot to sense something is near. Repeat this activity with the sound and light sensors.

## Expert Badges

Children who finish mastering all concepts quickly get to wear a badge that says "Sensor Expert." Sensor Experts walk around and offer help troubleshooting to any classmates experiencing difficulties attaching their sensors or programming with sensors.

## Collaboration *Web*

As children progress through the lesson, they will complete their collaboration webs. They will draw lines from their picture to the pictures of any classmates who give them help. If children say they didn't receive any help, remind them to think of their partners, class Experts, or if they got any ideas by looking at another classmate's project.

## Technology Circle (10 min)

Students share their creations. They may do one or more of the following: explain the blocks they used, talk about what they found easy and difficult, and share anything they changed from their original plan.

## Free-play (10-20 min)

Provide opportunities for children to program freely with KIBO using the Repeat Blocks and the light and distance sensors.

# Lesson 7: What are "Ifs"?

*Powerful Idea: Sensors and Branches*

## *Overview:*

Students program a robot vehicle to take different actions based on the state of a sensor.

| ***Prior Knowledge*** | ***Objectives*** | |
|---|---|---|
| | *Students will understand that…* | *Students will be able to…* |
| • The KIBO robot is a machine that can act on its own once it receives proper instructions.<br>• KIBO robots have special parts (i.e. motors, wheels, and a "brain"). Some of these special parts are called "sensors."<br>• KIBO robots scan blocks to learn a program<br>• Arranging and scanning blocks in a different order will result in a different program.<br>• Some instructions can be qualified with additional information. | • A robot can 'choose' between two sequences of instructions depending on the state of a sensor. | • Connect a light sensor to the robot.<br>• Identify a situation that needs a **branched program**.<br>• Make a program that uses a branch. |

## *Materials / resources:*

- KIBO Says game*
- One robot for each child or pair
- KIBO Distance and Light sensors
- One flashlight per child or pair
- KIBO Programming Blocks
- "Home" and destination icons or models
- Masking tape, to create "T" shaped road
- Engineering Design Journals *
- Collaboration Webs (one per child)

## *Lesson 7 Vocabulary:*

***Branched program*** – a program with two or more possible sequences
***Conditional*** – only happens sometimes

## *Activity description*

### How did Max Feel?

Children will talk about how Max may have felt when he yelled at his mother. What would have happened if Max hadn't felt wild and yelled? Children will create their own drawings and finish the statement "If I feel wild, I _____." This can also be with other If statements, such as "If I feel angry" or "If I feel happy."

### KIBO Says or Program the Teacher (10 min)

Play "*KIBO Says*" or "*Program the Teacher*" (see Lesson 3 for instructions) for students to practice recognizing the KIBO programming icons and creating programs. If playing "Program the Teacher," make sure to also create programs that use the Repeat and End Repeat blocks.

### Red Light, Green Light (5-10 min)

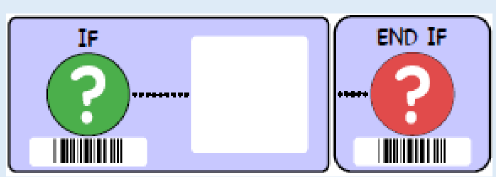
In small groups, have students take turns being the "Traffic cop." The Traffic cop gives out orders to the group such as "If green, go jump 3 times. If red, sit down." The Traffic cop then holds up either a red or a green piece of paper, and the other students in the group must complete the instructions accordingly. Try the game as a class first, and once the children feel comfortable with it, allow them to break into smaller groups and try being the Traffic cop themselves.

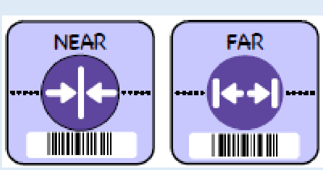
### Introduce the concepts and the task (10-15 min)

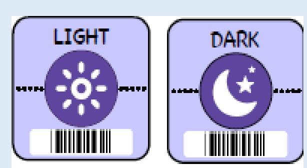
"In the programs that we have learned so far, the robot has only one choice of what instructions to do next. Today we will learn an instruction that gives the robot two choices. The robot uses a sensor to decide which set of instructions to follow each time the program is run." Discuss situations in the real world where someone may have to a choice (such as if it is rainy out, I'll bring an umbrella). Introduce the If and End-If blocks, as well as the Near/Far and Light/Dark parameters. Create the following program: Begin, If Near, Shake, End If, Sing, End. Demonstrate what happens when you do and do not put your hand in front of the sensor. Create another program using the light sensor and demonstrate the two situations, when you do and do not shine a light into the sensor.

## *What is an If Statement?*

*If Statements allow KIBO to make choices based on what it can sense, just like your students can! Use these four Parameters (below) with If Statements. Remember to attach the appropriate sensors!*



### Simon Says (5-10 min)

Play the traditional game of "Simon Says" to help the students gain familiarity with the thought process behind branches. For example, "Simon says, 'If the lights are on, jump twice, (if not, stand on one foot)."

### Individual/ Pair Work (20-25 min)

On a T shaped map on the floor, students will program their robot to drive home if it is dark and go to the land where the wild things are if it is light. Once students have successfully created a program with the light sensor, students will program their robot to with the light sensor.

### If Worksheet (5-10 min)

Students will complete a worksheet about their daily and weekly schedules. They will fill in the second half of an "If, then" statement such as "If it is Saturday, _________" in any way they want and draw a picture of the activity they're describing.

### Expert Badges

Children who finish mastering all concepts quickly get to wear a badge that says "If Expert." If Experts walk around and offer help to any classmates experiencing difficulties attaching their sensors or programming with Ifs.

### Collaboration *Web*

As children progress through the lesson, they will complete their collaboration webs. They will draw lines from their picture to the pictures of any classmates who give them help. If children say they didn't receive any help, remind them to think of their partners, class Experts, or if they got any ideas by looking at another classmate's project.

### Technology Circle (10 min)

Students share the program they made, what it does, and anything they found easy, hard, or surprising during the activity. Children sometimes think that Ifs make the robot do one program or the other *whenever* the sensor is in that state rather than as a one-time decision-maker for which set of instructions the robot will follow. This is important to identify and clarify with demonstrations.

### Free-play (10-20 min)

Let students explore building programs with the If blocks. This exploration gives them a chance to learn how to use the block in a program, think of situations that require it, and further understand how to use sensors.

# Lesson 8: The “Wild Rumpus” Project

## *Overview:*

Students will build and then decorate a KIBO robot as one of the wild things from the story *Where the Wild Things Are*. The decorations can be similar to one of the wild things that students saw in the story, or they can make up their own. Then, students will program their robots to do a wild rumpus! During the course of the final project, students put to use all the concepts learned during the previous lessons but transfer them to a new context. When possible, teachers should encourage the use of crafts and recycled materials.

*Note: Breaking the Lesson into Parts*

The work for the final project should be broken up into several sessions. It is up to the teacher when to complete each part of the project. Not all of the activities need to be completed during Robotics time. It is left up to the teacher’s discretion whether the students will build a new sturdy robot from scratch or will use the robots they build in earlier lessons.

## *Materials / resources:*

- *Where the Wild Things Are* by Maurice Sendak
- KIBO Says game (for review and reference displays)*
- One KIBO robot for each child or pair
- KIBO Programming Blocks
- A variety of crafts and recycled materials for building and decorating
- Large poster for a class timeline
- Photos/drawings of events from the year
- Engineering Design Journals*
- Collaboration Webs (one per child)

## *Activity description*

### KIBO Says or Program the Teacher

Play “KIBO Says” or “Program the Teacher” (see Lesson 3 for instructions) for students to practice recognizing the KIBO programming icons and creating programs.

### Individual/ Pair Work

Children will work individually to plan, design, build, and program a final project from scratch. Children will be encouraged to use advanced topics such as sensors and repeats when programming their robots.

1. Using their skills from Lessons 1 and 2, each child will build a sturdy robot and test it.
2. Children will create their own wild thing characters. They can make a character similar to what they saw in the *Where the Wild Things Are* book or they can create a new one. Children can use any art materials available to decorate their robots. They can then use popsicle sticks, tape, and other materials (except glue) to attach their wild thing to their robot.

3. As a class, create a backdrop for the wild rumpus. It may be helpful to look through the book for ideas on what the backdrop should have in it. Students can create one big mural together, or they could create individual scenery for their robots.
4. Using the backdrop and the story as inspiration, each child or pair will create a program for their robot that represents something that would happen during the wild rumpus. They should draw a picture and record the program in their engineering design journals.
5. For the final project display, bring all of the robots to the staging area, with the backdrop hung up or positioned in an appropriate way. Make sure each robot has enough room to execute their program without running into another robot.

### "Wild Rumpus" Ideas

There are a variety of ways students can program their robots do the wild rumpus. As long as students are challenging themselves and being creative, they should be allowed to program their robots however they want. It may be helpful to leave a copy of the book out for students to look at as they are working on their projects. Also, it may be helpful to show clips of the movie *Where the Wild Things Are* so that children can see different ways that the wild things move. Some ideas for kids include:

- Have two groups work together to create programs for their robots to dance a wild rumpus together
- Use the distance sensor to create a program that ensures the wild things do not run into any trees or other scenery parts
- Use the light sensor to start the wild rumpus in the dark forest

### *Invitations*

Write out and mail invitations to your family inviting them to come to your final project presentation. Add illustrations and information describing your project.

### Collaboration *Web*

As children progress through the lesson, they will complete their collaboration webs. They will draw lines from their picture to the pictures of any classmates who give them help. If children say they didn't receive any help, remind them to think of their partners, class Experts, or if they got any ideas by looking at another classmate's project.

### Presentations

*Students share*:

a. their robots and their decorations
b. why they chose the features they did for their robot
c. the final program(s) they made and what each represents
d. anything that was hard, easy, surprising, interesting, etc. about the process.

# Appendix A: Materials

This curriculum uses the KIBO robotics kit, developed at the DevTech Research Group at Tufts University and commercially available through KinderLab Robotics, Inc. Through KinderLab Robotics, Inc. supplementary materials that are used throughout this curriculum are also available (www.shop.kinderlabrobotics.com). However, teachers can create their own versions of these materials (denoted with an asterisk (*)),

### Robotics materials

- 1 KIBO robotics kit set per child, pair, or group
- Batteries (each KIBO runs on 4 AA batteries)

### Art Materials

- Various art materials including paper, scissors, markers, tape, and recyclable materials (glue is not advised)

### Teaching Materials

- Engineering Design Process Poster* (http://shop.kinderlabrobotics.com/Two-Posters-KIBO-and-Engineering-Design-Process-TM-POSTERS.htm)
- Engineering Design Journals* (http://shop.kinderlabrobotics.com/Engineering-Design-Journals-TM-JOURNAL.htm)
- KIBO Parts Poster* (http://shop.kinderlabrobotics.com/Two-Posters-KIBO-and-Engineering-Design-Process-TM-POSTERS.htm)
- Images for "Jump for Engineers" (Lesson 1)
- Images of vehicles for "Think Like an Engineer" (Lesson 1)
- Chart and images for "Jump for Robots" (Lesson 2)
- KIBO Says* game (or images of the blocks printed out largely on sturdy paper) (http://shop.kinderlabrobotics.com/KIBO-Says-Class-Programming-Game-TM-KIBO-SAYS.htm)
- KIBO Bingo*
- *My Five Senses* book by Aliki
- Engineer Licenses*
- Expert Badges*
- Assessment booklet for each student* (http://shop.kinderlabrobotics.com/Assessment-Packs-TM-ASSESSMENT.htm)

# Appendix B: Positive Technological Development

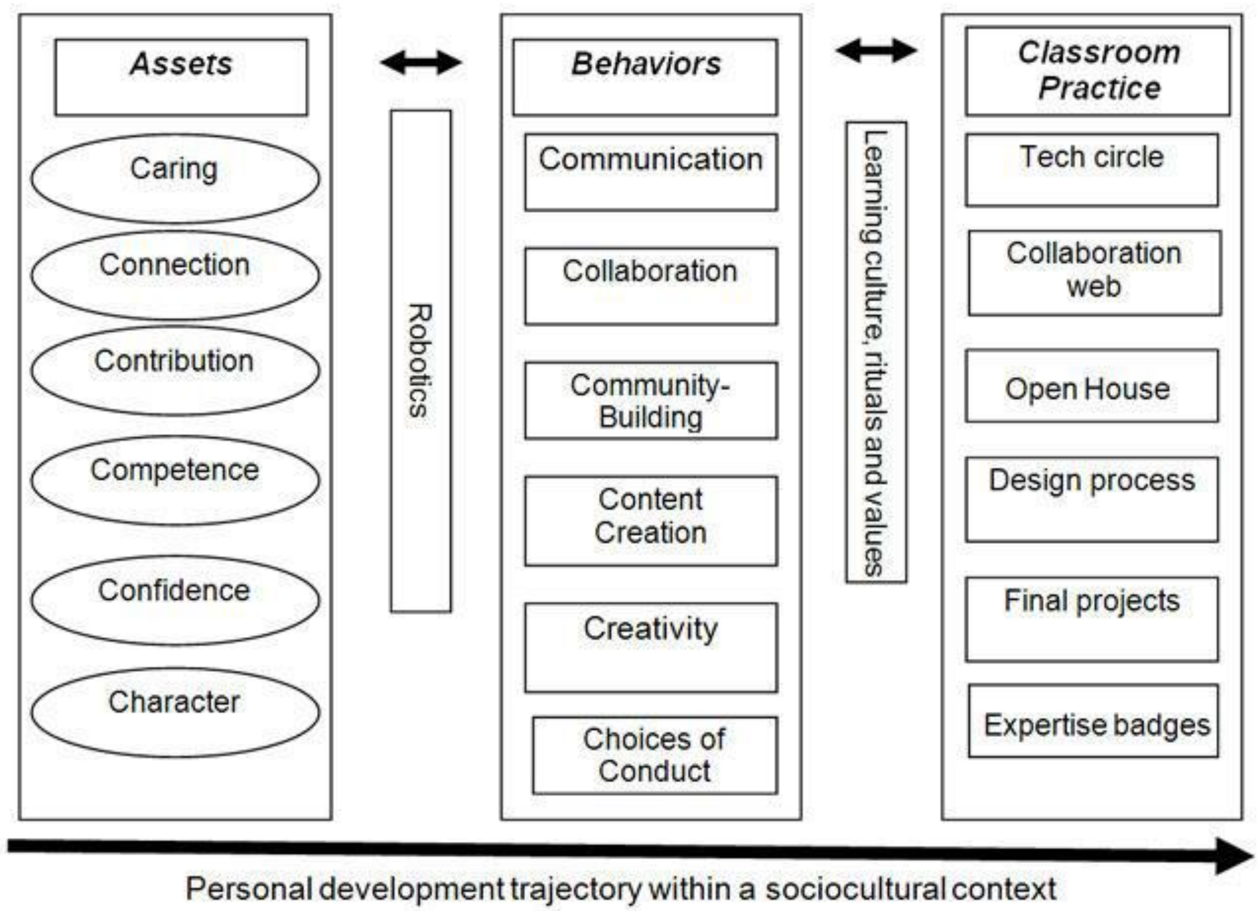
For further information about the Positive Technological Development framework, please refer to the following two books written by Dr. Marina Umaschi Bers:

Bers, M. (2008). *Blocks to Robots: Learning with Technology in the Early Childhood Classroom*. Teachers College Press, NY, NY.

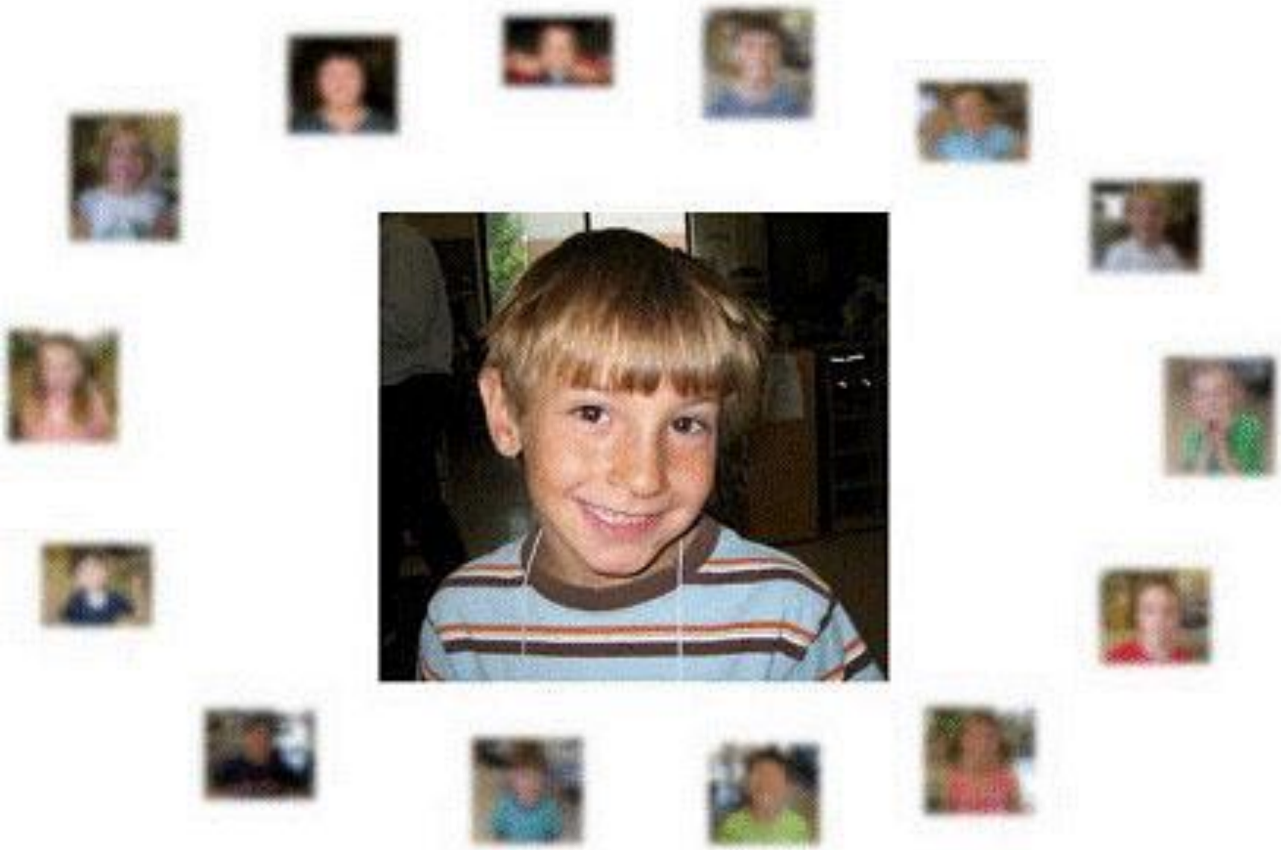
Bers, M. U. (2012). Designing digital experiences for positive youth development: From playpen to playground. Cary, NC: Oxford.

For academic publications on this topic, please visit the publications section of the DevTech Research Group's website: http://ase.tufts.edu/devtech/publications/.

*Personal Development Trajectory (figure taken from Bers, 2012)*



*Example Collaboration Web*



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Rinaldi, C. (1998). Projected curriculum and documentation. In C. Edwards, L. Gandini & G. Forman (Eds.), The hundred languages of children: The Reggio Emilia approach - Advanced reflections (pp. 113-125). Norwich, CT: Ablex Publishing.


## Acknowledgements


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