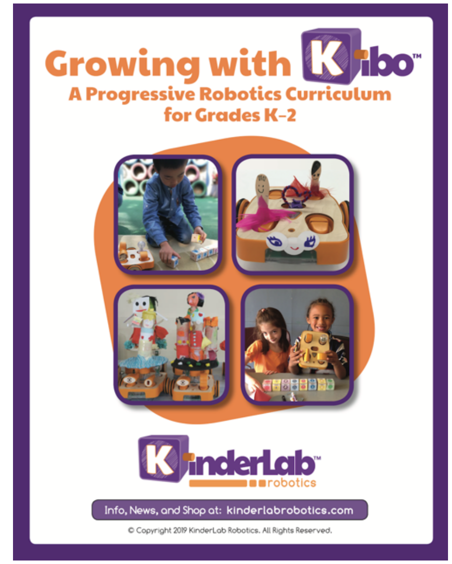
Growing with KIBO: Alignment with Georgia Standards of Excellence in Computer Science K – 2 (2019)



Implementing KIBO robotics as part of an integrated, STEAM-based curriculum in early childhood supports many of the Georgia Standards of Excellence in computer science for K – 2. KIBO curriculum is based on three intertwined threads: the engineering design process, computational thinking, and an arts-based curricular integration component. The curriculum emphasizes roles-based group work and collaboration, structured around the Positive Technological Development framework developed by KinderLab co-founder Dr. Marina Bers.

The alignment in this document refer to those standards most directly addressed by the lessons and pedagogy in our *Growing with KIBO* curriculum. However, educators can design educational experiences with KIBO to support all of the Georgia Standards of Excellence in K-2 CS using our curriculum as the foundation.

The final section of this document consists of a lesson mapping identifying how each lesson in *Growing with KIBO* addresses the key concepts and powerful ideas in computer science. Lessons are divided into Novice, Intermediate, and Advanced, roughly corresponding to K, 1, and 2. *Growing with KIBO* uses a spiral scope and sequence, wherein a common set of key concepts are addressed at each level, but in progressively greater depth.

For additional context, educators may also refer to the ISTE Standards for Students. The ISTE standards are one of the main inputs into the Georgia Standards of Excellence in computer science. An alignment document for *Growing with KIBO* with the ISTE standards is also available from KinderLab Robotics, Inc. at https://www.kinderlabrobotics.com/curriculum.

The standards text in this table is drawn from the *Georgia Standards of Excellence: Computer Science Standards (Kindergarten to Eighth Grade)*, available at https://www.georgiastandards.org/Georgia-Standards/Pages/Computer-Science.aspx.

References

- Bers, M. (2012). *Designing digital experiences for positive youth development: From playpen to playground*. Cary, NC: Oxford.
- International Society for Technology in Education (2016). *ISTE Standards for Students*. Retrieved from iste.org.
- Georgia Department of Education (2019). *Georgia Standards of Excellence: Computer Science Standards (Kindergarten to Eighth Grade)*. Retrieved from https://www.georgiastandards.org/

© 2022 KinderLab Robotics, Inc.

CSS.EL.K-2.1: Empowered Learner
"Recognize that technology provides the opportunity to enhance relevance, increase confidence, offer authentic choice, and produce positive impacts in learning."

***Growing with KIBO* Alignment Statement**
As noted in the Georgia Standards of Excellence, standard CSS.EL.K-2.1 states a general principle to be incorporated into all work with computer science in K-2 and should not be taught in isolation.

Growing with KIBO is built on the model of "digital fluency," or the ability to express oneself with technological tools. Coding (or programming) is a new kind of literacy. When creating with KIBO, young children learn programming ideas that are directly related to foundational concepts in math, literacy, science, and humanities. These include sequencing, modularity, cause-and-effect, and patterns.

Through cross-curricular projects, Growing with KIBO allows children to incorporate coding and building into explorations of other subjects of interest, using technology to "show what they know" just as they might by speaking, writing, or creating art.

The primary benefits of the KIBO program for students are mastery of computer science content appropriate to K-2, development of computational thinking skills, and engagement with the engineering design process. These STEM skills are supported by a social-emotional learning framework based on collaboration and group work.

© 2022 KinderLab Robotics, Inc.

CSS.KC.K-2.2: Knowledge Constructor
"Use digital tools (e.g. computers, tablets, cameras, software, 3D printers, etc....) to build knowledge, produce creative artifacts, and make meaningful learning experiences for themselves and others."

<table>
<tr><th>GA SoE Standards Element</th><th>Growing with KIBO Alignment Statement</th></tr>
<tr><td>1. Recognize the letters, numbers, and basic functions of a keyboard, touchpad/trackpad, mouse, and other input devices.</td><td rowspan="3">Growing with KIBO introduces basic robotic parts and hardware through direct instruction and hands-on experimentation. Growing with KIBO includes specific instruction in the functions of KIBO's different parts. By design, children can add and remove components to KIBO. They choose the capabilities of their robot based on the capabilities they need it to have to address the problem at hand. Although KIBO's robotics parts do not include mouse, keyboard, screens, or other traditional computing interfaces, children do learn the correspondence between hardware (parts) and functions of a computing system. The experience empowers students to see themselves as both users and designers of technological solutions.</td></tr>
<tr><td>2. Use the letters, numbers, and basic functions of the keyboard effectively (shift, space, tab, enter/return).</td></tr>
<tr><td>3. Identify and use the home row of the keyboard effectively.</td></tr>
<tr><td>4. Build (use, modify and/or create) collections of digital images and words to communicate learning using a variety of media types.</td><td rowspan="2">Growing with KIBO's integrated, cross-curricular projects -- such as creating robotic animals within ecosystems and programming robotic dancers representing different cultures -- allow students many opportunities to incorporate research and connection-making. Students do not use KIBO to perform research, but they can work with library/media specialists to gather information, examples, and context to support their creations.</td></tr>
<tr><td>5. Analyze collections of digital images and words for how well each collection communicates learning.</td></tr>
<tr><td>6. Identify a problem of interest to the learner and create a solution using digital tools.</td><td>Creating personally meaningful projects is a cornerstone of Growing with KIBO's constructivist pedagogy. Many individual lessons and longer projects in the curriculum involve connections to students' wider communities and real world challenges. Discussion of these community relationships is an explicit component of these projects. For example, one integrated project asks students to create robotic helpers based on "real life heroes" such as public servants, doctors, and teachers.</td></tr>
</table>

© 2022 KinderLab Robotics, Inc.

CSS.KC.K-2.3: Digital Citizen
"Identify the rights, responsibilities, and opportunities of living, learning, and working in an interconnected society and model behaviors that are safe, legal, and ethical."

<table>
<tr><th>GA SoE Standards Element</th><th>Growing with KIBO Alignment Statement</th></tr>
<tr><td>1. Identify personal information, understand the need to keep it private, and engage in activities for keeping personal information private.</td><td rowspan="3">Not applicable. Digital / internet security is not addressed in Growing with KIBO.</td></tr>
<tr><td>2. Participate in systems for keeping personal information private and protected (for example: passwords, biometric sensors).</td></tr>
<tr><td>3. Understand shared information on the Internet can be permanent.</td></tr>
<tr><td>4. Recognize and avoid harmful behaviors in online environments (e.g. viruses, in-app purchases, cyber-bullying, etc.).</td><td rowspan="3">Growing with KIBO is deeply informed by Dr. Marina Bers' Positive Technological Development pedagogy, as expressed in her 2012 book Designing Digital Experiences for Positive Youth Development. Teachers and students are encouraged to experiment with "what if" questions and potential consequences as they use technology, and to provoke examination of values and exploration of character traits while working with robotics. Although there is no online component to KIBO work, responsible use of technology (such as taking good care of devices and sharing limited resources) is a focus.</td></tr>
<tr><td>5. Follow safety rules and exhibit responsibility when using a device.</td></tr>
<tr><td>6. Create an artifact that shows the use of positive safe behavior when using technology.</td></tr>
<tr><td>7. Recognize work that is created by others.</td><td rowspan="2">Students are encouraged to recognize the contributions and collaborations with other students through acknowledgement of idea-sharing at circle discussions. These sharing relationships are made concrete through artifacts like "collaboration webs" – diagrams that show which classmates helped each student with their project. Sharing is framed as a natural part of the engineering process.</td></tr>
<tr><td>8. Recognize that credit is given for the work of others found online.</td></tr>
<tr><td>9. Create an artifact that demonstrates a positive personal digital identity.</td><td>Coding is presented as a literacy, through which children express and share their identity. Sharing work allows students to perceive the impact that their self-expression has on their peers and community.</td></tr>
</table>

© 2022 KinderLab Robotics, Inc.

CSS.IDC.K-2.4: Innovative Designer and Creator
"Use the Design Process (use, modify, create) with a variety of tools to identify and solve problems by creating new, modified, or imaginative solutions."

Note: The Engineering Design Process as represented in Growing with KIBO consists of 6 steps: ASK, IMAGINE, PLAN, CREATE, TEST+IMPROVE, and SHARE.

GA SoE Standards Element	***Growing with KIBO* Alignment Statement**
1. Understand that a model is used for developing and testing ideas for a diverse range of users.	The TEST+IMPROVE step of the Engineering Design Process receives a special focus throughout the curriculum. Students are encouraged to test their "finished" projects early, identify aspects of their work that do not function according to their plan, seek feedback from peers on possible improvements, and implement their changes. "Engineering circles" – regular whole-class meetings set aside for this sharing and feedback gathering – reinforce these behaviors.
2. Modify an existing model for a specific purpose or for a specific group of users.	
3. Create and test a model and analyze it from the perspective of an end user.	
4. Recognize that innovation in technology meets a range of needs (3D printing, coding, robotics, drones, etc.).	The PLAN and CREATE phases of the Engineering Design Process provide an opportunity to engage with constraints, available materials, and design trade-offs. Within the context of the sensors, output devices, and other components available in the KIBO Robot Kit, students make decisions about which parts and components will meet their design needs.
5. Understand that innovation follows a process such as system life cycle, engineering design (use, modify, create) or design thinking (empathize, define, ideate, prototype and test.	Student work with building and programming the KIBO robot and designing their solutions is structured using the Engineering Design Process, with students learning to ASK, IMAGINE, PLAN, BUILD, TEST+IMPROVE, and SHARE their constructions. Students are introduced to the steps of the Engineering Design Process early in the curriculum, and they use these steps and the associated vocabulary throughout their project work.

© 2022 KinderLab Robotics, Inc.

CSS.IDC.K-2.5: Computational Thinker
"Develop and employ Computational Thinking strategies (break-down, find patterns, and create algorithms) to identify and solve problems."

GA SoE Standards Element	***Growing with KIBO*** **Alignment Statement**
1. Recognize that problems can be broken down into smaller parts in order to create a solution. Vocabulary Term: Decompose (to break down)	Students are encouraged during several lessons to apply decomposition techniques to simplify more complex problems. Working collaboratively, students break problems down into parts, then design solutions to those individual parts: for example, programming each leg of a maze-navigation program separately.
2. Identify patterns.	Students engage with patterns through the powerful idea of "control structures" in computer science, including the use of repeat loops. Repeat loops are taught as patterns of repeated behavior, such as alternating the robot's output light between two colors.
3. Create and use Algorithms (a set of step-by-step instructions) to complete a task.	Students create of algorithms to solve problems and express ideas throughout their work with KIBO. Students practice sequencing techniques as they program KIBO; using these techniques, students gain experience in framing the original problems in ways that can be addressed through a sequenced algorithm.
4. Use Algorithms (a set of step-by-step instructions) to construct programs (using a block- based programming language or unplugged activities) that accomplish a task as a means of creative expression.	
5. Identify multiple ways solutions can be applied to solve problems. Vocabulary Term: Abstraction	Students engage with abstraction through powerful idea of representation. Students learn that symbols represent commands, commands represent actions, and programs can represent behaviors. These programs can be re-used in different contexts to address different problems.
6. Analyze and debug (identify and fix) with or without a computing device.	Development of computational thinking, sequencing skills, decomposition, and algorithmic thinking are benefits of working with KIBO's tangible, screen-free coding language. Programming a robot allows children's work with computational thinking to impact the physical world, bringing a concrete element to computational thinking which is especially helpful in early childhood.

© 2022 KinderLab Robotics, Inc.

CSS.IDC.K-2.6: Creative Communicator
"Use digital tools to creatively share and express ideas."

GA SoE Standards Element	***Growing with KIBO*** **Alignment Statement**
1. Create a variety of artifacts.	Growing with KIBO is designed to increase students' "digital fluency" by giving them a strong foundation in expressive robotics and coding. As students progress through their technological education, they will gain familiarity with other tools and their palette of available expressive tools will increase from this foundation.
2. Exchange information or ideas clearly and creatively using digital tools while considering audience and intended purpose.	Sharing work is an important aspect of the Constructivist pedagogy in Growing with KIBO. Sharing work allows students to perceive the impact that their expressive work has on their peers and community. Each project in Growing with KIBO culminates in a project showcase. The SHARE step of the Engineering Design Process contextualizes the act of sharing within the overall cycle.
3. Present information using a digital device.	In early childhood education, coding is most effective when it is paired with concrete, hands-on work in the physical world. Robotics involves designing, building, constructing, and decorating in addition to coding; students create with both digital tools (code) and physical ones. The expressive constructions their build with KIBO, combined with the behaviors created with algorithms and code, serve as a visualization tool for children to share their ideas.
4. Create artifacts for specific purposes that give and receive feedback.	Students are encouraged to recognize the contributions and collaborations with other students through acknowledgement of idea-sharing at circle discussions. Feedback and contributions are encouraged and sought formally during the process. Sharing and feedback relationships are made concrete through artifacts like "collaboration webs" – diagrams that show which classmates helped each student with their project. The sharing of ideas is framed as a natural part of the engineering process.

© 2022 KinderLab Robotics, Inc.

CSS.IDC.K-2.7: Global Collaborator
"Use digital tools to collaborate with others both locally and globally."

GA SoE Standards Element	***Growing with KIBO*** **Alignment Statement**
1. Identify technology (hardware and software) that allows collaboration with others.	*Not a primary focus: Although small-group collaboration is a key aspect of Growing with KIBO's pedagogy, collaborative online technologies per se are not used.*
2. Use digital tools to connect with individuals from different backgrounds and cultures.	Growing with KIBO's integrated, cross-curricular projects, such as programming robotic dancers representing different cultures, include an emphasis on authentic cross-cultural connections. Student projects can also showcase students' own backgrounds, families, cultures, and countries of origin.
3. Understand features of online environments.	*Not applicable: KIBO does not include any online component. However, a school's online sharing software could be used to present student work (e.g. an online showcase).*
4. Participate in various roles on a team to work on a common goal and create an inclusive environment.	Students contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal." Working with KIBO, children can take on different roles in the engineering process, such as builder, coder, scanner, and tester. Students are also asked to reflect and share at "technology circles" during the process. These techniques are based in the research of KinderLab co-founder Dr. Marina Bers, who established a framework for positive youth development through working with technology.
5. Participate in an online collaborative learning environment.	*Not applicable: KIBO does not include any online component. However, some lessons could be conducted via remote learning.*

© 2022 KinderLab Robotics, Inc.

CSS.IDC.K-2.8: Reflective Researcher
"Select appropriate sources to conduct authentic research to produce a relevant and credible product."

GA SoE Standards Element	***Growing with KIBO*** **Alignment Statement**
1. Understand that answers to questions can be found through research from a variety of sources. 2. Understand that resources on the Internet vary in quality and are found in a variety of places so care is needed in selection. 3. Understand there is an appropriate place to find information to research the answer to a question. 4. Progress from using a teacher developed list of resources, to selecting resources independently. 5. Select digital and analog resources, explain why a source was selected, and describe why it was the best source.	Growing with KIBO's integrated, cross-curricular projects -- such as creating robotic animals within ecosystems and programming robotic dancers representing different cultures -- allow students many opportunities to incorporate research and information gathering. Students do not use KIBO to perform research, but they can work with library/media specialists to gather information, examples, and context to support their creations. Students do not use the internet directly as part of any lesson, but teachers can still incorporate a discussion of the internet along with other sources.
6. Collect and organize data. 7. Create a product of research collaboratively or independently. (e.g., table of data, writing assignment, collection of resources). 8. Create and share a research project reflecting and crediting a variety of quality resources.	Students use robotics as a tool for modeling and representation. Linking to the concept of "digital fluency," students use programs to express, explore, and represent cross-curricular knowledge. For example, students program KIBO to move specific distances in the context of modeling arithmetic operations on a number line. Or students may decorate KIBO to resemble an animal, build a habitat out of arts and crafts materials, and program KIBO to represent the behavior of the animal in its habitat. Research is a critical component of the PLAN and CREATE phases of the design process for such projects, and students document their research and sources in their Engineering Design Journals.

© 2022 KinderLab Robotics, Inc.

Growing with KIBO Spiral Scope and Sequence:
The Powerful Ideas of Computational Thinking and Robotics with KIBO

We address all of the powerful ideas at each level. We return to them and expand coverage at the next level.

Powerful Idea	NOVICE	INTERMEDIATE	ADVANCED
ALGORITHMS	Sequencing	Sequencing	Sequencing
		Expressiveness	Expressiveness
			Problem Solving
MODULARITY	Decomposition	Decomposition	Decomposition
		Program Design	Program Design
			Reusability
CONTROL STRUCTURES	Patterns	Patterns	Patterns
		Repeat Loops	Repeat Loops
		Conditionals	Conditionals
			Nesting
REPRESENTATION	Symbols	Symbols	Symbols
		Variables	Variables
		Store and Recall	Store and Recall
			Models & Visualization
HARDWARE AND SOFTWARE	Parts and Functions	Parts and Functions	Parts and Functions
		Input and Output	Input and Output
			Advanced Sensors
ENGINEERING DESIGN PROCESS	Ask, Imagine, Plan, Create, Test & Improve, Share		
SOCIAL - EMOTIONAL LEARNING	Personal Development, Collaboration, and Digital Citizenship		

Sources:

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

Bers, M. (2018). Coding as a playground: Programming and computational thinking in the early childhood classroom. New York, NY: Routledge press.

K–12 Computer Science Framework. (2016). Retrieved from http://www.k12cs.org.

© 2022 KinderLab Robotics, Inc.

Growing with KIBO CS Concept Coverage by Lesson
Novice Lessons

	Novice Lessons																
	1	2	3	4	5	6	7	8	9	10,11	12	13	14	15	16	17	18-20
ALGORITHMS																	
Sequencing		•	•	•			•		•		•	•		•			
Expressiveness													•			•	
Problem Solving																	
MODULARITY																	
Decomposition				•					•		•			•			
Program Design																	
Reusability																	
CONTROL STRUCTURES																	
Patterns			•						•		•	•		•			
Repeat Loops																	
Conditionals																	
Nesting																	
REPRESENTATION																	
Symbols		•	•														
Variables																	
Store and Recall																	
Models and Visualization																	
HARDWARE+SOFTWARE																	
Parts and Functions	•					•		•					•				
Input and Output													•			•	
Advanced Sensors																	
DESIGN PROCESS																	
				•	•	•	•								•		
SOCIAL / EMOTIONAL LEARNING																	
			•												•	•	

© 2022 KinderLab Robotics, Inc.

Growing with KIBO CS Concept Coverage by Lesson

Intermediate Lessons

						Intermediate Lessons											
	1	2	3	4	5	6,7	8	9	10	11	12	13	14	15	16	17	18-20
ALGORITHMS																	
Sequencing		•															
Expressiveness				•	•					•							
Problem Solving																•	
MODULARITY																	
Decomposition		•															
Program Design		•	•					•			•	•					
Reusability																	
CONTROL STRUCTURES																	
Patterns		•															
Repeat Loops	•	•	•				•		•	•							
Conditionals				•	•				•	•							
Nesting																	
REPRESENTATION																	
Symbols																	
Variables		•					•		•								
Store and Recall								•				•					
Models and Visualization											•	•					
HARDWARE+SOFTWARE																	
Parts and Functions													•	•	•		
Input and Output				•	•				•	•	•	•	•				
Advanced Sensors									•	•							
DESIGN PROCESS																	
	•							•				•	•	•	•	•	
SOCIAL / EMOTIONAL LEARNING																	
					•				•	•							

© 2022 KinderLab Robotics, Inc.

Growing with KIBO CS Concept Coverage by Lesson

Advanced Lessons

	Advanced Lessons															
	1	2	3	4	5	6	7,8	9	10	11	12,13	14	15	16	17	18-20
ALGORITHMS																
Sequencing																
Expressiveness				•	•								•			
Problem Solving		•	•			•		•	•	•		•			•	
MODULARITY																
Decomposition																
Program Design		•	•			•				•		•	•	•		
Reusability																
CONTROL STRUCTURES																
Patterns																
Repeat Loops		•													•	
Conditionals		•	•	•										•		
Nesting					•	•						•		•		
REPRESENTATION																
Symbols																
Variables															•	
Store and Recall															•	
Models and Visualization				•	•	•									•	
HARDWARE+SOFTWARE																
Parts and Functions								•	•	•						
Input and Output					•											
Advanced Sensors		•	•	•		•						•		•		
DESIGN PROCESS																
	•							•	•	•						
SOCIAL / EMOTIONAL LEARNING																
													•			

© 2022 KinderLab Robotics, Inc.