LEGO® Education
Computer Science Learning Progression

SPIKE™ Essential Grade 2

Introduction

LEGO® Education believes that students learn best through play—by actively doing, exploring, and experimenting. This approach empowers them to become creative and engaged lifelong learners, which is essential for success in their future careers and lives.

Read this Introduction to explore ways to use this learning progression and find activities that support your learners.

This learning progression organizes activities in a recommended sequence that supports students' successful learning with LEGO® Education SPIKE™ Essential. For classroom convenience, it also clusters activities that use the same model.

Following the recommended sequence ensures that students build the necessary knowledge and experience for each successive activity. However, you may also choose activities according to your students' needs and prior knowledge/experience.

Some activities are reprinted or modified from published LEGO Education sources. Others are developed especially for these learning progressions.

Each activity

- ☑ contains anticipated timing, topics, relevant standards, learning objectives, and a ready-to-use prompt.
- ☑ is labeled with one or more topics, such as Modify Programs (computer science), or Narrative Writing (ELA).
- ☑ lists the relevant standards, beginning with the most important standard in the learning.

To find what you need,

- ☑ scan the Topic(s) & Standards column or search with terms like *CSTA*, *ELA*, or *Math*.
- ☑ use the **Key** below to locate activities of different lengths and levels of instructional support.
- ☑ use the **Additional Resources** below to locate more support.

Key

1 Numbers show the recommended order in which to use activities.

Activities that will take approximately 20–30 mins

LESSON Longer activities with full lesson support

PROMPT Short activities to quickly expand or extend the learning

Activities that use only bricks and require no hardware/software

or Activities that will take approximately 45 or 90 mins

MORE DETAILS Links that lead to lesson details and teaching support

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Additional Resources on the LEGO® Education Community

- ☑ *SPIKE™ App Help* Definitions and directions for using the coding blocks located in the HELP section of the LEGO® Education SPIKE™ App
- ☑ *Curriculum Integration Guide* SPIKE Essential activities organized by domain Also contains a protocol for integrating activities into your curriculum
- ☑ *Coding Blocks in LEGO® Education SPIKE™ Essential Lessons*
- ☑ *Basic Coding Concepts in LEGO® Education SPIKE™ Essential Lessons*
- ☑ *Troubleshooting with LEGO® Education SPIKE™ Essential*
- ☑ *Computational Thinking in LEGO® Education SPIKE™ Essential Lessons*

#	Activity Name	Topic(s) and Standards	Objectives Students will	Prompt
1 🕒	PROMPT **Brick-tionary with Bricks** 	**CSTA Core Practice** **Collaborating Around Computing** **Design Engineering** **NGSS K-2-ETS1-2** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	• Identify a model as a representation of an object or phenomenon. • Understand ways to use models to communicate ideas for solving problems.	Use a simple hands-on game activity to introduce students to the LEGO® Education SPIKE™ Essential set and the engineering concept of modeling. 1. Organize groups of 4 2. Provide each student with LEGO® bricks and a stack of cards labeled with recent vocabulary study or familiar objects. Use pictures if your students aren't ready to read the cards. 3. Have students take turns privately reading a card and then building a model of it for partners to guess. Emphasize that the model represents, or stands for, the idea on the card. **Say/Ask** *Take turns drawing a card. Don't show it to anyone! Then use LEGO bricks to build what you see on it. What is your model? Have your classmates try to guess.*
2 🕒	PROMPT **Back-to-Back with Bricks** 	**Sequences** **CSTA 1A-AP-12** Develop plans that describe a program's sequence of events, goals, and expected outcomes.	• Investigate what makes a sequence by practicing creating step-by-step instructions. • Understand the importance of clear steps and directions.	Use a simple follow-the-steps activity to introduce students to the coding concept of sequencing. 1. Organize pairs and provide each partner with the same 3-4 bricks. Students can sit back-to-back. If facing each other, have students place a divider between them. 2. Designate a student A and a Student B 3. Ask Student A to build a model with the bricks, then without showing the model, communicate the steps to build the same model to their partner. 4. Partners can switch roles and repeat the process. Optional: o You can allow a partner to ask clarifying questions o You can increase the number of bricks for the builds. **Say/Ask** *Build a model. Without showing the model, tell your partner the exact steps to build it. What happens?* **More Details** *Basic Coding Concepts*

3 🕒	**PROMPT** **Get Moving with the Motor** 	**SEQUENCES/LOOPS** **CSTA K–2 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **COMPUTING TERMINOLOGY** **CSTA 1A-CS-02** Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).	• Follow instructions to create a program. • Explore programming a motor. • Use appropriate terminology when using hardware.	1. Introduce students to the motor in their set as they apply icon bricks sequencing to a simple computer program. 2. Students will create a program to move the piece in two different directions at two different speeds. **SAY** *Connect a small motor to your hub. Add an axle and any piece you like to the end of it. Then create a program to move the piece in two different directions and at two different speeds.* **MORE DETAILS** *The Motor* tutorial in the START section of the LEGO® Education SPIKE™ App, available on the web or downloaded.

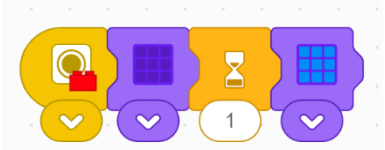
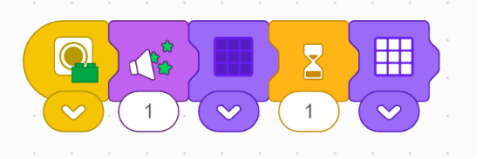
	**The Color Sensor** **MORE DETAILS** *The Color Sensor* tutorial in the START section of the SPIKE App, available on the web or downloaded.			
#	**Activity Name**	**TOPIC(S) and Standards**	**Objectives** Students will	**Prompt**
4 🕒	**PROMPT Get Moving with the Color Sensor**	**SEQUENCES/LOOPS** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **COMPUTING TERMINOLOGY** **CSTA 1A-CS-02** Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).	• Follow instructions to create a program. • Use appropriate terminology when using hardware.	1. Introduce the Color Sensor as students use sequences to create movement if colors are sensed. 2. Students will create a program to move a LEGO brick or element when the color sensor detects blue. **SAY** *Connect a small motor and the Color Sensor to your hub. Add an axle and any piece you like to the end of it. Create a program that uses the Color Sensor to move the piece when blue is detected.* ***Then try this>****Add two movements. Trigger each with a different color.*
5 🕒	**PROMPT Making Music**	**SEQUENCES/LOOPS** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **COMPUTING TERMINOLOGY** **CSTA 1A-CS-02** Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).	• Follow instructions to create a program. • Use appropriate terminology when using hardware.	1. Review how to connect the color sensor with students. 2. Ask students to find a programming block that will make a sound. 3. Ask students to create a program that plays a sound when the sensor detects blue. 4. Challenge students to program the sensor to play a different sound when it detects another color. **SAY** *Connect the Color Sensor to the hub. Create a program that plays a sound when the sensor turns blue.* ***Then try this>****Program music for a story you built or wrote.*

6 🕒	**PROMPT** **Meet the Team: Minifigure Bios**	**SEQUENCES** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem.	• Design and program a simple model that moves using a motor.	1. As a class, read the bios for Maria, Daniel, Sofie, and Leo. 2. Ask students to think about a team mascot. What kind of mascot would they have? What would the mascot's name be? Brainstorm ideas. 3. Have students build a model of their mascot using the motor from SPIKE essential and other bricks in the set. Have students use the program from the motor tutorial to make their motors move. Students can add the color sensor and sound. 4. Have students share their build with another pair, explaining the team mascot they selected for the SPIKE Essential minifigure team.

		The Light Matrix **More Details** *The Light Matrix* tutorial in the START section of the LEGO® Education SPIKE™ App, available on the web or downloaded		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
7 🕒	**Prompt** **Creating Patterns**	**Sequences/Loops** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **Computing terminology** **CSTA 1A-CS-02** Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).	• Follow instructions to create a program. • Use appropriate terminology when using hardware.	1. Introduce the Light Matrix as students learn to program it to show color according to input from the Color Sensor. 2. Students will program the light matrix to show a color when the color sensor detects blue. 3. Then challenge students to create a pattern using the light matrix when different colors are sensed. **Say** *Connect the Color Sensor and the Light Matrix to your hub. Program the Light Matrix to show a color when the Color Sensor senses blue.* ***Then try this>*** *Create a pattern with the Light Matrix. Program the Color Sensor to change the Light Matrix when different colors are sensed.*
8 🕒	**Prompt** **Sending Signals**	**Sequences/Loops** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **Computing terminology** **CSTA 1A-CS-02** Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).	• Follow instructions to create a program. • Use appropriate terminology when using hardware.	1. *Review the following* a. *how to connect the light matrix* b. *how to connect the color sensor. Explain that both sensors will be connected to the hub.* c. *how to program the light matrix to display a pattern when the color sensor detects blue.* 2. *Have students program the light matrix to display a different pattern when the color sensor detects red.* 3. *Then ask students to make a secret code to send using the light matrix and the color sensor.* **Say** *Make a secret code to send with the Light Matrix! Connect the Color Sensor and the Light Matrix to your hub. Send your secret code to a teammate across the room or table. See if your teammate can decode the message.*
9 🕒	**Prompt** **Rectangular Arrays**	**Sequences** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem.	• Use the Light Matrix to display a rectangular array. • Tell and write an equation to reflect what they see.	1. Extend students' use of the Light Matrix to simple multiplication. 2. Review how to connect and program the light matrix. 3. Prompt students to program the Light Matrix to show a group of lights arranged in a rectangular array (e.g.

		MATHEMATICAL OPERATIONS **CCSS.MATH.Content.2.0A.C.4** Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends.		two rows of three lights). Using addition, have students determine the total number of illuminated lights on the light matrix. Students can then write an equation to express the total sum of equal addends. (3+3). 4. Challenge students to program the light matrix to display other rectangular arrays and use addition to determine the total number of lights illuminated. **SAY/ASK** *Connect the Light Matrix to your hub. Program the Light Matrix to show two groups of three lights. Use a math sentence to describe what you see. How many lights are there?*
10	**PROMPT** **Guess My Brick**	**DEVICE/INTERNET SECURITY** **CSTA 1A-NI-04** Explain what passwords are and why we use them and use strong passwords to protect devices and information from unauthorized access.	• Define the purpose of passwords. • Identify the features of a strong password.	Introduce students to the concept of passwords with a bricks-only activity. 1. Organize pairs to create a password with LEGO bricks. Provide bricks. Designate a student A and a Student B 2. Student A chooses a brick as the password and then hides all the bricks. 3. Student B guesses the brick by naming its color. Partners then take turns making more complex passwords by adding criteria, such as number of studs (bumps), special use (e.g., wheels, gears), etc. **SAY/ASK** *Take turns using bricks as passwords. First, choose one brick as your password. Hide it and all the bricks. Can your partner guess the color? Next, make the passwords harder. Add more things to guess, like the number of bumps on the brick. Can your partner guess?*

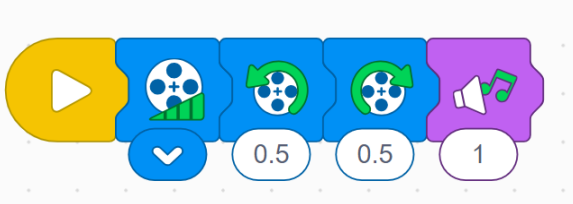
	**The Fast Lane**			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
11 	**Lesson** **The Fast Lane**	**Sequences/Loops** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **Design Engineering** **NGSS K-2-ETS1-1** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	• Develop and modify programs with sequences and simple loops to solve a problem. • Practice brainstorming to generate ideas. • Practice helping a story character. • Describe key ideas or details from a text.	1. Follow the lesson plan for The Fast Lane. Students will generate and modify a program using the Color Sensor and Light Matrix. **Say** *Help Leo enter the amusement park with the Fast Lane! Create and test the program that turns on the light when Leo shows his yellow ticket to the Color Sensor.* **More Details** *The Fast Lane lesson* or access in the LEGO® Education SPIKE™ App.

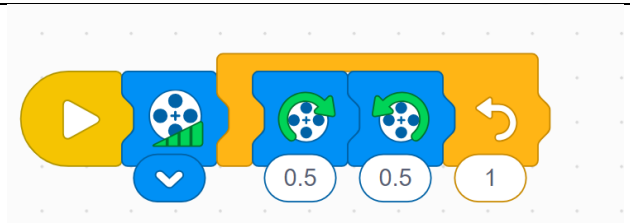
12	**PROMPT** **Debugging Challenge**	**COMPUTATIONAL THINKING** **CSTA 1A-AP-14** Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.	• Identify and fix errors in a program (test and debug).	Remind students that debugging is a method for finding and fixing mistakes in a program if it doesn't produce the desired results. 1. Share the following code with students:  2. Explain that Leo wants to turn on the blue light when he shows a blue ticket to the color sensor. 3. Prompt students to run the program to find and fix the bug. 4. Ask students to explain how they found the problem and what steps they took to fix it. Challenge students with this harder problem to debug: When Leo shows the color sensor a green ticket, he want to play a sound with clapping, wait a second then turn on the green light. His program isn't working properly. Can you fix it? 
13	**PROMPT** **More with Computer Science**	**IMPACTS OF TECHNOLOGY** **CSTA 1A-IC-16** Compare how people live and work before and after the implementation or adoption of new computing technology.	• Consider how technology has changed the way we live and act. • Develop a model to explain the process of entering the park without a sensor or scanner. • Practice brainstorming to generate ideas.	1. Review the Fast Lane lesson with students 2. Have students build and program a new model to show the experience of entering the park without scanning technology. **SAY/ASK** *What was it like to collect tickets before we had the technology to scan them? Build an experience Leo would have entering the park if he couldn't scan his ticket. Could you use other technology? Change your build or make a totally new entrance.*

		**Classic Carousel**		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
14 🕒🕒	**Lesson** **Classic Carousel**	**Sequences/Loops** **CSTA 1A-AP-12** Develop plans that describe a program's sequence of events, goals, and expected outcomes. **Design Engineering** **NGSS K-2 ETS 1-1** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. **Skill Practice: Forces and Motion**	• Develop and modify sequence of events and outcomes of programs. • Improve and refine a prototype as part of the design process. • Practice helping a story character. • Describe key ideas or details from a text.	1. Follow the lesson plan for Classic Carouse. Students will use sequencing and the engineering design process to build and program a spinning ride for Sofie. **Say** *Create a new spinning ride for Sofie to try! Then create and modify the program to move the ride.* **More Details** *Classic Carousel* lesson or access in the LEGO® Education SPIKE™ App
15 🕒	**Prompt** **Debugging Challenge**	**Computational Thinking** **CSTA 1A-AP-14** Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.	• Identify and fix errors in a program (test and debug).	Remind students that debugging is a method for finding and fixing mistakes in a program if it doesn't produce the desired results. 5. Share the Carousel Chaos debugging challenge with students. 6. Prompt students to run the program to find and fix the bug. 7. Ask students to explain how they found the problem and what steps they took to fix it.

16	PROMPT **More with ELA**	**COMPUTATIONAL THINKING** **CSTA 1A-AP-08** Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks. **NARRATIVE WRITING** **CCSS.ELA-Literacy.W.2.3** Write narratives in which they recount a well-elaborated event or short sequence of events, include details to describe actions, thoughts, and feelings, use temporal words to signal event order, and provide a sense of closure.	• Write a story that includes a short sequence of events. • Use a motor block and sound block to help tell a story. • Describe key ideas or details from a text.	1. Ask students to use the Classic Carousel model to create a new story about Sofie's adventure. Have students brainstorm what Sofie might be thinking or feeling in the story. 2. The story needs to include: a. a short sequence of events told in order b. a motor block c. a sound block that helps them tell a story by showing its setting. d. An ending for the story 3. Have students use the model to help write their story. Once finished, ask students to share their stories with another group. **SAY** *Write a story about Sofie's experience at the amusement park. Include time words to show the order that things happen.*

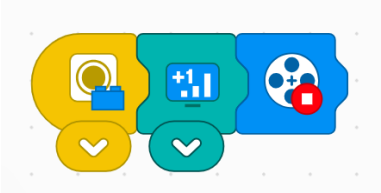
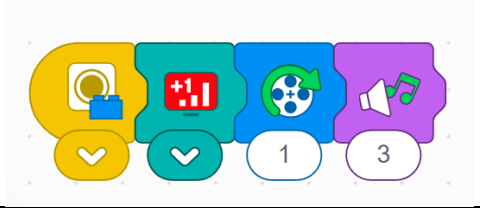
#	Activity Name	TOPIC(S) & Standards	Objectives Students will	Prompt
17	LESSON **Food Video Production**	**COMPUTATIONAL THINKING** **CSTA 1A-AP-11** Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions. **DESIGN ENGINEERING** **NGSS K-2-ETS1-2** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	• Design and build a model tripod to meet specific user needs. • Break down the problem to identify what's needed in a strong solution. • Program the model to meet at least one identified need, like a hands-free start and stop.	1. Have students design a tripod to help Video Food Producer, Rie, capture video of her recipes. 2. Consider recommending a sensor that allows for easily starting and stopping the tripod. **SAY** *Design, build, program and iterate on a tripod that will help Rie capture video of making her recipes. She wants to show different angles at different heights so that her viewers understand all the steps in the recipe.* **MORE DETAILS** *Rebuild the World with Food Video Production*

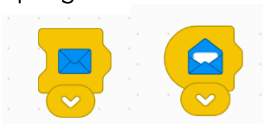
		The Perfect Swing		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
18 Lesson **Part A**		**Sequences/Loops** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **Design Engineering** **NGSS K-2-ETS 1-2** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	• Gather information about the needs or wants of others. • Change a solution to meet the needs or wants of others. • Practice helping a story character. • Describe key ideas or details from a text.	1. Use the lesson plan for The Perfect Swing. After students build the model swing, have them create and modify a program to meet Maria's needs. Reinforce that she wants a swing that doesn't go very fast. Guide students to change only the program. **Say/Ask** *Build the swing. Will Maria like it? She doesn't want a ride that goes too fast. Create a program that makes the swing work for her. Change it so it works even better. For now, just change the program. We'll get to the model soon!* **More Details** *The Perfect Swing* lesson or access in the LEGO® Education SPIKE™ App
19 Prompt **Debugging Challenge**		**Computational Thinking** **CSTA 1A-AP-14** Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.	• Identify and fix errors in a program (test and debug).	Remind students that debugging is a method for finding and fixing mistakes in a program if it doesn't produce the desired results. 1. Share the following with students. Maria wants the swing to move slow, back and forth, then play soft music. Her program has two errors. Can you find them?  Have students program the swing using the code above to detect and fix the bugs. 2. Then challenge students with a new problem. Maria wants her swing to move slowly, back and forth 5 times. There seems to be a problem. Can you fix the program to make the swing move back and forth?

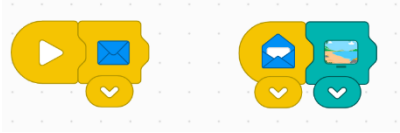
				
20 🕒🕒	**PROMPT** **More with Math and ELA**	**COLLECT DATA** **CSTA 1A-DA-06** Collect and present the same data in various visual formats. **LANGUAGE** **CCSS.ELA-Literacy.L.2.1** Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. **MEASUREMENT AND DATA** **CCSS.MATH.Content.2.MD.10** Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.	• Collect and analyze data on likes and dislikes. • Create different types of charts to present information. • Use computing tools to create and present visual artifacts.	1. Have students interview their classmates to learn what they like and don't like about different amusement park rides. Establish common criteria, such as "rides that go fast" or "rides that spin around," so students can show yes/no answers as the data in different charts and graphs. 2. Review familiar picture and bar graphs from students' math studies. 3. Challenge students to use the color sensor and bar graph blocks to gather opinions about amusement park rides from their classmates. **SAY** *Talk to some classmates. Ask what they like or don't like about different amusement park rides. Use yes or no questions like "Should rides go faster? Should they go slower?" "Should they spin you around?" Write down the answers. Then show them in a bar graph and a picture graph you create on the computer or with your SPIKE App.* **MORE DETAILS** *Bar Graph Blocks* in the HELP section of the SPIKE App, available on the web or downloaded.

21 🕒🕒	**LESSON** **Part B**	**SEQUENCES** **CSTA 1A-AP-12** Develop plans that describe a program's sequence of events, goals, and expected outcomes. **MODIFY PROGRAMS** **CSTA 1A-DA-05** Store, copy, search, retrieve, modify, and delete information using a computing device and define the information stored as data.	• Change a solution to meet the needs or wants of others. • Retrieve and modify an existing program to use a tool in a different way. • Design and test prototypes to ensure they meet a need.	1. Review The Perfect Swing lesson 2. Review classroom data collected about amusement park rides. 3. Have students use the information and data from their interviews to build a new swing for their classmates. Guide them to open and retrieve their code from *The Perfect Swing* lesson and modify it for the new swing. **SAY/ASK** *Now, use what you learned from classmates to build a new swing they will like. What should it be like? Open the code you made for Maria's swing. What will need to change to make your new swing move?* **MORE DETAILS** *The Perfect Swing* lesson or access in the LEGO® Education SPIKE™ App
22 🕒	**PROMPT** **More with Computer Science and Math**	**MODIFY PROGRAMS** **CSTA 1A-DA-05** Store, copy, search, retrieve, modify, and delete information using a computing device and define the information stored as data. **MEASUREMENT AND DATA** **CCSS.MATH.Content.2.MD.A.1** Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.	• Retrieve and modify an existing program to use a model in a different way. • Use appropriate tools to count and measure the different heights on the Ferris wheel.	1. Build The Perfect Swing model 2. Provide measuring tools to students (e.g., rulers) 3. Have students program their swing to stop at different heights, such as halfway or a fourth of the way to the top. Have students estimate, then measure the different heights to the nearest inch or centimeter. For an extra challenge, have students measure the swing at the top and subtract the other values to compare the differences. **SAY** *Daniel wants to swing really high! His friends are curious how high he can go. Help them determine different heights the swing can reach by measuring the distances from the ground.* ***Then try this>*** *Measure from the top to the new heights.*

	**Snack Stand**			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
23 LESSON	LESSON	**Computational Thinking** **CSTA 1A-AP-11** Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions. **Design Engineering** **NGSS K-2-ETS1-3** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	• Practice testing prototypes to ensure that they meet a need. • Modify and remix a solution. • Practice helping a story character. • Describe key ideas or details from a text.	1. Use the lesson plan for Snack Stand. Students will create and modify a program so that Daniel gets a new snack when he presents his blue ticket. 2. Guide them to break down the problem into its parts before they begin to program. **Say/Ask** *Oh no! Daniel dropped his snack. Help him get a new one from the snack stand! What problems must you solve? Create and test a program so the Color Sensor reacts to Daniel's blue ticket. Be sure he can reach his new snack.* **More Details** *Snack Stand* lesson or access in the SPIKE App
24 PROMPT	**More with Math**	**Collect Data** **CSTA 1A-DA-06** Collect and present the same data in various visual formats **Measurement and Data** **CCSS.MATH.Content.2.MD.10** Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. .	• Collect and analyze data on likes and dislikes. • Create different types of charts to present information. • Use computing tools to create and present visual artifacts.	1. Using the Snack Stand model, have students program the Color Sensor to react to other colors that represent snacks Daniel's friends want. 2. Have students use the collected data from the snack stand to create a bar graph on paper, with manipulatives and with the Bar Graph block in their LEGO® Education SPIKE™. Discuss which color was used the most, least, etc., and some different ways to display the data with computing tools. **Say** *Daniel and his friends want different snacks. Give each snack type a blue, yellow, red, or green ticket, and then let the friends each select two snacks from the stand. Change your program so the Color Sensor reacts to these colors. Show the snack choices in a picture or bar graph on the computer or in the SPIKE App.* **More Details** *Bar Graph Blocks* in the HELP section of the LEGO® Education SPIKE™ App, available on the web or downloaded.

25	**PROMPT** **Debugging Challenge**	**COMPUTATIONAL THINKING** **CSTA 1A-AP-14** Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.	• Identify and fix errors in a program (test and debug).	Remind students that debugging is a method for finding and fixing mistakes in a program if it doesn't produce the desired results. 3. Share the following with students. Daniel's snack stand has stopped giving snacks. He thinks there is a problem with the code. Can you find the bug and fix it?  Have students program the swing using the code above to detect and fix the bugs. Then challenge students with the next problem. 4. Daniel wants his graph to show the number of times he asks for a blue snack. He would also like a funny "boing" sound to play after the snack is delivered. Can you find the bugs in the program and fix them? 

26	**PROMPT** **Send a Message**	**DECOMPOSITION** **CSTA 1A-AP-11** Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions. **SEQUENCES/LOOPS** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem.	• Understand how a message block functions in a program. • Create a simple program using a message block.	1. Explain to students that you are going to play a message game. Show students a blue LEGO brick from the SPIKE Essential set. Tell students when you show the blue block it is a trigger for them to clap three times. Practice showing the brick to students and having them clap three times. 2. Next, explain that you are going to start marching in place. Whenever you show them the blue block, they will clap three times then stop, but you will keep marching. 3. Open the SPIKE Essential app. Select a new project using ICON Blocks. Show students these two blocks in the program.  4. Ask students what these blocks look like (envelope, message, open a letter) These are called the Send Message block and the Received Message Block. 5. Explain to students that the Send Message block is a trigger block used to send a secret message in your program. It is always used with the Received Message block, and they need to be the same color. When you use a Send Message block in a program, the computer program will run the code following the corresponding Received Message block. The Send Message block is similar to showing the blue LEGO brick in our game. It was a trigger to have something happen. Students seeing the blue LEGO brick, then clapping is similar to how the Receive Message block functions. 6. Challenge students to create a very simple program using the SPIKE Essential hub. Have students write a program so that when you click play, the

				computer sends a blue message. When the blue message has been received it will show an image.  7. Encourage students to explore other ways they can use the message blocks in SPIKE Essential. **More Details** Information on how to use the *Receive Message* and *Send Message* blocks can be found in the HELP section of the SPIKE App, available on the web or downloaded.

		**Twirling Teacups**		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
27	**Lesson**	**Create Programs** **CSTA 1A-AP-08** Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks. **Sequences** **CSTA 1A-AP-12** Develop plans that describe a program's sequence of events, goals, and expected outcomes. **Design Engineering** **NGSS K-2-ETS1-1** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	• Modify a solution while considering a specific goal or outcome. • Refine and improve the prototype. • Practice helping a story character. • Describe key ideas or details from a text.	1. Follow the lesson plan for Twirling Teacups. 2. After students build the spinning ride, prompt discussion about what Sofie and Leo might want the ride to do. For example, maybe they want space for their friends OR for all the seats to spin or move. Guide students to program the model to meet some of the new needs. If you wish, also allow them to redesign the model. **Say** *Sofie and Leo are excited to try a new spinning ride. Build the ride and program it to move. Then change your program to meet some new needs, like space for more of the friends. Make sure the seats spin or move so the ride is still exciting! Test and make your program work even better!* **More Details** *Twirling Teacups* lesson or access in the LEGO® Education SPIKE™ App
28	**Prompt** **Gyro Sensor** 	**Sequences/Loops** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **Computing terminology** **CSTA 1A-CS-02** Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).	• Follow instructions to create a program. • Use appropriate terminology when using hardware.	1. To prepare students for the next spinning ride activity, introduce them to the Gyro Sensor that is built into the hub. 2. Use gestures to clarify tilting and explain that the Gyro Sensor recognized movement like this. 3. Then have students complete the Built-In Gyro Sensor tutorial activity. **Say** *Learn how to use the Gyro Sensor that is built into the hub. Connect a motor to the hub with Port A. Write the program to use the Gyro Sensor to make the motor turn. Tilt the hub and see what happens.*

				MORE DETAILS *The Gyro Sensor* tutorial in the START section and *Tilt Sensor Block* in the HELP section of the SPIKE App, available on the web or downloaded.
29	**PROMPT** **More with the Gyro Sensor**	**SEQUENCES/LOOPS** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **DESIGN ENGINEERING** **NGSS K-2-ETS 1-2** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	• Design, program, and iterate on a model. • Program movement based on using the Gyro Sensor.	1. Have students apply their learning about the Gyro Sensor to build and program a simple spinning ride similar to their teacup model. 2. Prompt them to program the ride to move different ways based on the tilt of the Gyro Sensor. **SAY** *Build another spinning ride like the twirling teacups. Use the Gyro Sensor to start the spinning motion. To do that, program the ride to move different ways based on the tilt of the Gyro Sensor in the hub. Then tilt away!*
30	**PROMPT** **More with ELA**	**IMPACTS OF COMPUTING** **CSTA 1A-IC-16** Compare how people live and work before and after the implementation or adoption of new computing technology. **RESEARCH WRITING** **CCSS.ELA-Literacy.W.2.7** Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). **PERSUASIVE WRITING** **CCSS.ELA-Literacy.W.2.1** Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., because, and, also) to connect opinion and reasons, and provide a concluding statement or section.	• Compare how technology has changed the way we find information over time. • Use research sources or personal experience to identify different amusement park rides. • Write a paragraph to persuade classmates why one ride is the best one.	1. Review the lesson Twirling Teacups with students. 2. Spark a discussion for different ways we can find information on a topic we want to learn more about. 3. Ask students how people before computers had to find information (book, magazines) and how technology has helped make finding information easier. 4. Have students research different rides in an amusement park, select their favorite, and write a persuasive paragraph about why it's the best ride. As needed, build prior knowledge and provide research sources, especially for students unfamiliar with amusement parks. Review persuasive writing features. **ASK/SAY** *What do you think is your favorite amusement park ride? Research to learn about different rides. Then write a paragraph to persuade your friends why it's the best ride.*

		**The Spinning Ferris Wheel**		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
31 🕒🕒	**Lesson**	**Modify Programs** **CSTA 1A-AP-14** Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops. **Design Engineering** **NGSS K-2-ETS1-1** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	• Modify an existing solution to make it work properly. • Practice helping a story character. • Describe key ideas or details from a text.	1. Follow the lesson plan for Spinning Ferris Wheel. 2. After students build the Ferris wheel, prompt discussion about how the team can ride it together. Guide students to try programming the model to stop at a quarter turn so each of the friends can get on. Encourage them to use loops. **Say** *The team wants to ride the Ferris wheel together. Help them stop the ride so each of the friends can get on. Use a loop in your program. See if you can make the ride stop after a quarter turn.* **More Details** *The Spinning Ferris Wheel* lesson or access in the LEGO® Education SPIKE™ App; *Forever Loop* and *Repeat Loop (Control Blocks)* in the HELP section of the SPIKE App
32 🕒	**Prompt** **More with Loops**	**Sequences/Loops** **CSTA 1A-AP-10** Develop programs with sequences and simple loops, to express ideas or address a problem. **Modify Programs** **CSTA 1A-DA-05** Store, copy, search, retrieve, modify, and delete information using a computing device and define the information stored as data. **Narrative Writing** **CCSS.ELA-LITERACY.W.2.3** Write narratives in which they recount a well-elaborated event or short sequence of events, include details to describe actions, thoughts, and feelings, use temporal words to signal event order, and provide a sense of closure.	• Follow instructions to create a program. • Modify the program with loops to make the Ferris wheel stop after each quarter turn. • Develop a story focused on retelling events.	1. Review the Spinning Ferris Wheel Lesson. Have students build the model. 2. Explain the two loop types available in the LEGO® Education SPIKE™ App. The Repeat Loop block (a *for* loop) repeats all the blocks inside it a certain number of times, like 3. The Forever Block (a *while* loop) repeats all the blocks inside it forever. Guide students to explore these different ways to make the Ferris wheel loop and to create stories for why the team might like each way. **Say/Ask** *Leo notices there are two different ways to make the Ferris Wheel loop. Explore the two looping options in the SPIKE App. How are they different? Create a story for how the friends might use each type of loop to create a fun ride.* **More Details** *Forever Loop* and *Repeat Loop Blocks (Control Blocks)* in the HELP section of the LEGO® Education SPIKE™ App, available on the web or downloaded.

33	**PROMPT** **Debugging Challenge**	**COMPUTATIONAL THINKING** **CSTA 1A-AP-14** Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.	• Identify and fix errors in a program (test and debug).	Remind students that debugging is a method for finding and fixing mistakes in a program if it doesn't produce the desired results. 8. Share the A Bug in the Ferris Wheel debugging challenges with students. 9. Prompt students to run the program to find and fix the bug. 10. Ask students to explain how they found the problem and what steps they took to fix it.
34	**PROMPT** **More with Math**	**DECOMPOSTION** **CSTA 1A-AP-11** Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions. **GEOMETRY** **CCSS.MATH.Content.2.G.A.3** Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.	• Describe portions of the Ferris wheel circle as halves, thirds, or fourths • Modify an existing solution to make it meet different needs.	1. Review the Ferris Wheel lesson. 2. Prompt students to redesign the Ferris wheel so people can only ride on some of the seats. Have them try half the seats, a third of the seats, and then a fourth of the seats. Guide students to draw their thinking and explain the equal or unequal shares and shapes they created. **SAY/ASK** *Imagine some of the Ferris wheel seats are broken, so you want people to ride on only part of the wheel. Start with half the seats, then try a third and a quarter. Draw your ideas, using shapes to show which parts of the Ferris wheel circle people can ride on. Explain why each drawing meets each situation. Which shapes are equal? Which are unequal?*

#	Activity Name	TOPIC(S) & Standards	Objectives Students will	Prompt
35	**LESSON** **Remix the Ride** 	**DEVELOP PROGRAMS** **CSTA 1A-AP-13** Give attribution when using the ideas and creations of others while developing programs. **DESIGN ENGINEERING** **NGSS K-2-ETS1-1** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	• Brainstorm to generate ideas for completing an amusement park ride. • Develop communication skills as they articulate their ideas for rebuilding and remixing an amusement park ride. • Practice giving and receiving feedback.	1. To prepare for the open-ended activities 36-38, have students use the engineering design process to brainstorm new ideas for an amusement park ride. **SAY** *It's time to help get an unfinished ride ready for the amusement park! Work together to brainstorm ideas for the new ride.* **MORE DETAILS** *Remix the Ride* lesson

	**The Most Amazing Amusement Park**			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
36 🕒🕒	**Lesson Part A**	**Design Engineering** **NGSS K-2-ETS1-1** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. **Sequences** **CSTA K–2 1A-AP-12** Develop plans that describe a program's sequence of events, goals, and expected outcomes. **Computational Thinking** **CSTA K–2 1A-AP-11** Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.	• Apply their engineering design skills to solve a problem. • Practice helping a story character. • Describe key ideas or details from a text. • Break down the problem to identify what's needed in a strong solution.	1. Lead discussion to summarize or continue the brainstorming from *Remix the Ride*. 2. Then have students design a new ride for the amusement park, using at least one motor or sensor. Encourage the class to suggest multiple ideas. 3. If you wish, have students draw their ideas first. You might also provide additional materials to support further creativity. **Say** *Get ready to create a new ride for the amusement park. Explore ideas that include at least one motor or sensor, like the Color Sensor.* **More Details** *The Most Amazing Amusement Park* lesson or access in the LEGO® Education SPIKE™ App
37 🕒🕒	**Lesson Part B**			1. Have students build their ideas for a new ride, then program and test to improve the ride. **Say** *Build your ideas and program your ride to be fun for the team. Remember to use at least one motor or sensor, and to test your program at least two times. Each time, find ways to make it work a little better.* **More Details** *The Most Amazing Amusement Park* lesson or access in the SPIKE App
38 🕒	**Prompt More with ELA: Part C**	**Narrative Writing** **CCSS.ELA-LITERACY.W.2.3** Write narratives in which they recount a well-elaborated event or short sequence of events, include details to describe actions, thoughts, and feelings, use temporal words to signal event order, and provide a sense of closure.	• Write a paragraph for a story, describing thoughts and feelings about an event.	1. Have students write a description of their amusement park rides, explaining why they're fun and exciting. **Ask/Say** *What makes your ride fun and exciting? Imagine Sofie, Daniel, Leo, or Maria is telling the others. Write a paragraph to describe the ride and their feelings about it.*