LEGO® Education
STEAM Learning Progression

SPIKE™ Essential Grade 5

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 Forces and Motion (science), Modifying Programs (computer science), or Narrative Writing (ELA).
- ☑ lists the relevant standards, beginning with the most important standard in the learning. For example, a science activity will list NGSS standards first, while a computer science activity will list CSTA standards first.

To find what you need,

- ☑ scan the Topic(s) & Standards column or search with terms like *Forces and Motion* or *CSTA*.
- ☑ explore and choose from selected paths on page 3.
- ☑ 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 use only bricks and require no hardware/software

Activities that will take approximately 20–30 mins

or Activities that will take approximately 45 or 90 mins

LESSON Longer activities with full lesson support

PROMPT Short activities to quickly expand or extend the learning

MORE DETAILS Links that lead to lesson details and teaching support

Additional Resources (also see 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*

GRADE 5

Complete the full STEAM Progression in Activities 1–58

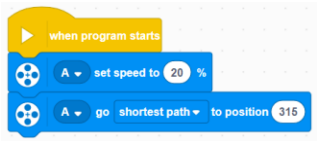
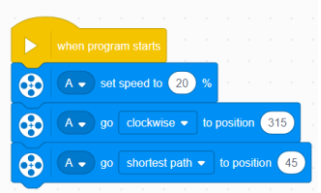
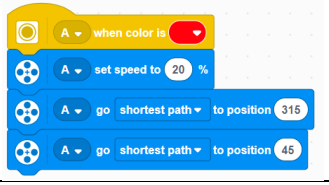
OR

choose from one of the paths.

COMPUTER SCIENCE PROGRESSION	SCIENCE PROGRESSION	DESIGN ENGINEERING PROGRESSION	SKILLBUILDERS AND EXTENSIONS
Good Morning Machine (Activities 3–5)	*Matter* (Activities 7–10)	*Good Morning Machine* (Activities 3–5)	Meet the Hardware (Activities 2, 22, 25)
Driving Around (Activities 16–18)	*Gravity* (Activities 12–15)	*Driving Around* (Activities 16–18)	ELA/Literacy (Activities 5, 10–11, 15–16, 26, 32, 35, 37, 41, 43, 45–46, 55)
Big Little Helper (Activities 19–21)	*Daytime and Nighttime* (Activities 27–29)	*Big Little Helper* (Activities 19–21)	Math (Activities 6, 9, 16, 18, 21, 24–25, 29–30, 38, 40, 43, 48, 52, 54)
High-Tech Playground (Activities 22–26)	*Protect the Environment* (Activities 33–35)	*High-Tech Playground* (Activities 22–26)	
Trash Monster Machine (Activities 30–32)	*Energy Flow* (Activities 36–37)	*Trash Monster Machine* (Activities 30–32)	
Winning Goal (Activities 38–41)		*Winning Goal* (Activities 38–41)	
Literary Randomizer (Activities 42–43)		*Literary Randomizer* (Activities 42–43)	
Your School Creation (Activities 44–45)		*Your School Creation* (Activities 44–45)	
		Build to Launch (Activities 46–51)	

#	Activity Name	Topic(s) and Standards	Objectives Students will	Prompt
1	PROMPT **Counter-balance the Bricks**	**Design Engineering** **NGSS 3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **NGSS 3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	• Design and build a model that requires a counterbalance for stability. • Test to determine if the model works as intended.	Introduce students to design engineering and model-building with a simple bricks-only activity. Share or reinforce that *counterbalance* "describes forces that can keep heavy objects from falling over, e.g., on the back of a crane." (Show pictures of cranes as needed.) Organize groups and provide each with the same number of bricks. Prompt groups to test how many bricks they can get to hang off the table (extending beyond the surface of the table). They will need to create a counterbalance on the table to keep the bricks from falling. **Say** *Build a model that works like a crane. It should use weight to counterbalance the load that is suspended. Use bricks to extend a model off the edge of the table. Then add a counterbalance to keep them from falling.*
2	PROMPT **Meet the Motor**	**Sequences** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Computing Systems** **CSTA 3-5 1B-CS-02** Model how computer hardware and software work together as a system to accomplish tasks.	• Follow instructions to create a program. • Explore programming a motor. • Use appropriate terminology when using hardware.	Introduce students to the motors in their set as they apply bricks-only sequencing to a simple computer program. **Say** *Connect two motors to your hub. Add an axle and any piece you like to the end of each. Create a program to move the pieces using the motor and movement blocks. Try to move them in the same direction, at the same speeds, then two different directions and at two different speeds then move one motor while the other is stopped.* **More Details** *Motor Blocks* in the Help section of the LEGO® Education SPIKE™ App, available on the web or downloaded. (For connection steps, review *The Motor* tutorial in the START section.)

	Good Morning Machine			
#	Activity Name	Topic(s) & Standards	Objectives Students will	Prompt
3	LESSON	**Design Engineering** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	• Define and understand a problem. • Brainstorm and iterate to create a solution that meets the described needs.	Have students use both engineering design and programming to build and program a waving machine so Leo can say "good morning." Prompt them to upgrade the build and program.

		DEVELOP PROGRAMS **CSTA 3-5 1B-AP-17** Describe choices made during program development using code comments, presentations, and demonstrations.	• Engage effectively in a range of collaborative discussions.	**SAY** *Leo is frustrated that he can't say "good morning" to his friends. He's too short and gets lost in the crowd. Help Leo by building and programming a waving machine.* **MORE DETAILS** *Good Morning Machine lesson* or access in the LEGO® Education SPIKE™ App.
4 **PROMPT** **More with Computer Science**		**COMPUTATIONAL THINKING** **CSTA 3-5 1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.	• Identify the parts of an existing program that should be modified. • Carry out tests to identify where a program can be modified.	Discuss debugging and prompt students to practice with the code examples below. For each example, have them try the program to see if they can find the mistake. Then ask how they fixed it. **SAY/ASK** *Leo is having problems with some programming. Can you help? Look at each example. Try it. What is the mistake? How can you fix it?* **Example**  **Example**  **Example** 
5 **PROMPT** **More with ELA**		**RESEARCH FOR WRITING** **CCSS.ELA-Literacy.W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. **CCSS.ELA-Literacy.W.5.8** Recall relevant information from experiences or gather	• Combine information from several research sources to build knowledge about greetings in different cultures. • Use personal experiences to identify different types	Have students conduct a short research project about how people from different cultures greet each other in the morning. As needed, direct them to appropriate research sources or search terms. If you wish, start by prompting sharing of different personal experiences with greetings, and encourage students to use each other as sources.

		relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.	of greetings.	**SAY/ASK** *How do you say good morning to your family or friends? How do we say good morning in class? Learn more about ways that people in different cultures greet each other in the morning. Use people you know and text or media research. Share what you learn.*

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6 🕒	PROMPT 	**MEASUREMENT AND DATA: VOLUME** **CCSS.MATH.Content.5.MD.C.3** Recognize volume as an attribute of solid figures and understand concepts of volume measurement. **CCSS.MATH.Content.5.MD.C.4** Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.	• Use models to explain the concept of volume. • Measure volume in units of cubic studs.	Provide each student with 12 LEGO® bricks. Use the bricks to introduce or reinforce the concept of volume. Show boxes or other cubes, and identify their three dimensions—height, weight, and depth. Explain that we calculate volume by multiplying these three measurements. For example, a 2x2 LEGO brick is 2 studs wide, 2 studs deep, and has 1 stud of height. Thus, its volume is 1 x 2 x 2 = 4 cubic studs. Have students build their own model with all flat sides (no parts sticking out). Ask them to calculate the volume in studs, assuming that all bricks are 1 stud high and counting the studs on top for the other measurements.) Then have them measure a partner's model, remeasuring until both measurements agree. **SAY/ASK** *Let's look at volume using some LEGO bricks. Build a model that's like a box. All flat sides with nothing sticking out. Then use studs as a unit to measure. How tall is it? How wide is it? How deep is it? Calculate the volume. Trade with a partner and measure each other's models. Do you get the same volume measurement? Why not? Remeasure until you and your partner agree.*

	**Matter**		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
7 🕒 🕒	LESSON **Part A**	**STRUCTURE & PROPERTIES OF MATTER** **NGSS 5-PS1-1:** Develop a model to describe that matter is made of particles too small to be seen.	• Develop a motorized fan that is able to blow over a paper tower a short distance away.	Have students build a fan that can make a breeze to blow over a paper tower. (See the lesson for a template to build the paper tower.) Then have them program it to make the fan spin at different speeds. Prompt them to test and observe the effect of the fan's performance by positioning the paper

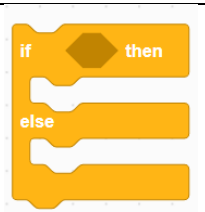
		COMPUTATIONAL THINKING **CSTA 3-5 1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.	• Explain that although air particles are too small to see, they are pushed by the fan against the paper to knock it over. • Test and modify the model and program to improve its performance at different speeds.	tower 1) in the front, 2) at one side, or 3) at different distances from the fan. **SAY** *Maria notices that when she opens the window, her papers blow around the room. How does that happen? Build and program a fan to help Maria learn. Have the fan spin at different speeds, starting with 100%. Then place the paper tower 1) in the front, 2) at one side, or 3) at different distances from the fan. Notice what happens.* **MORE DETAILS** *Matter* lesson or access in the LEGO® Education SPIKE™ App
8 🕒🕒	**LESSON** **Part B**			Have students iterate and test their models to design a better fan blade. Encourage them to try materials like cardboard or others that you provide. **SAY/ASK** *Try to improve your fan's performance by designing a better fan blade. Use cardboard or other materials. Test your fan again. What happens?* **MORE DETAILS** *Matter* lesson or access in the LEGO® Education SPIKE™ App
9 🕒	**PROMPT** **More with Math**	**NUMBERS AND OPERATIONS: FRACTIONS** **CCSS.MATH.Content.5.NF.B.4** Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.	• Measure fan blades to ¼ of an inch. • Use addition or multiplication to determine the total available width of fan blade surface. • Analyze how additional width affects the performance of the fan.	To further explore the fan's performance, have students measure the width of each blade (at the widest point) to at least ¼ of an inch. Then prompt them to determine the total width of fan surface used in each trial (i.e., if two blades were used, add the width of each together OR multiply the width by 2). Lead comparison discussion of how adding width to the blades affected the fan's performance and at what point using blades stopping making a difference. **SAY/ASK** *Try to improve your fan's performance by finding the best width for the fan blades. For each set of fan blades you tested, measure the fan blades to the ¼". Multiply the result by the number of blades on the fan. How does adding width to the blades affect the fan's performance? Does the improvement continue as you make the blades even wider?*
10 🕒	**PROMPT** **More with ELA**	**INFORMATIVE WRITING** **CCSS.ELA-Literacy.W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information.	• Write an editorial or advertisement for the Beaufort scale. • Express an opinion on	Provide learning materials about the Beaufort scale, which is used to measure the force of wind. Have students produce an editorial or advertisement for the Beaufort scale explaining

			why it's an effective measurement tool.	why it is useful to have a scale to measure wind rather than using people's subjective impressions. **SAY** *Learn about the Beaufort scale, which is used to measure the force of wind. Then write an editorial or ad for the scale explaining why it's more useful than subjective impressions like* windy *or* gusty.

#	Activity Name	TOPIC(S) and Standards	Objectives Students will	Prompt
11 🕒	PROMPT **More with ELA**	**SPEAKING AND LISTENING** **CCSS.ELA-Literacy.SL.5.1.B** Follow agreed-upon rules for discussions and carry out assigned roles. **DESIGN ENGINEERING** **NGSS 3-5 ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	• Practice communication skills through collaborative retellings. • Take turns to retell beginning, middle, and end of a familiar story. • Design and build models to represent the beginning, middle, and end of the story.	Organize pairs to collaboratively retell a familiar story, taking turns to tell the beginning, middle, or end. Prompt them to build three models—one each to represent the beginning, middle, and end. If time allows, invite pairs to use their models to retell the story to the class. **SAY** *With your partner, retell a familiar story. Build three models, one that shows the beginning, one that shows the middle, and one that shows the end. Use the models as you take turns telling the parts of the beginning, middle, and end of the story.*

Gravity

#	Activity Name	TOPIC(S) & Standards	Objectives Students will	Prompt
12 🕒	PROMPT **More with Computer Science**	**SEQUENCES** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **COMPUTER SCIENCE SKILL PRACTICE: CONDITIONALS** Prepare for the *Gravity* lesson.	• Program conditionals using the If/Then/Else block.	Prompt students to explore the *If/Then/Else* block while using the Built-in Gyro Sensor (part of the hub). Ask them to create three different ways to use this block to cause an action such as playing a sound when tilted in one direction but playing a different sound if not tilted in that direction. **SAY** *Explore ways to use the If/Then/Else block with the Built-in Gyro Sensor. Find three ways to use this block to play one sound when the hub is tilted in one direction and another sound if not tilted in that direction.*

				 **MORE DETAILS** *If/Then/Else Blocks* (*Control Blocks*) in the Help section of the LEGO® Education SPIKE™ App, available on the web or downloaded.
13 **LESSON** **Part A**	**BALANCED AND UNBALANCED FORCES; GRAVITY** **NGSS 5-PS2-1**: Support an argument that the gravitational force exerted by Earth on objects is directed down. **COMPUTATIONAL THINKING** **CSTA 3-5 1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.		• Build a device that demonstrates that the gravitational force exerted by Earth pulls objects down, toward Earth's center. • Use the device to explain the bird's behavior in terms of the downward force of gravity.	Have students build a balancing bird model for Daniel, showing that the downward force of gravity will keep the bird in its original upright position when tilted. Prompt them to use the Built-in Gyro Sensor with Event and Sound Blocks to program their model to make different bird sounds when it is tilted to the right or to the left and when it is upright. **SAY** *Daniel loves the way birds stay balanced, even when a branch moves. Help him make a model bird that can stay balanced too. Program it to make different bird sounds when it is upright, and when it is tilted to the right or left. Use the Built-in Gyro Sensor with Event and Sound Blocks.* **MORE DETAILS** *Event, Sound Blocks* in the Help section of the SPIKE App; *Gravity* lesson or access in the SPIKE App, available on the web or downloaded.
14 **LESSON** **Part B**				Have students investigate what happens when they turn their birds 160 degrees (almost upside down) and let go. Then prompt them to build a balancing bird model that does not include the Hub (and its Built-in Gyro Sensor) but stays upright, even after it's tilted. **SAY** *Suppose you didn't have a Gyro Sensor. Rebuild your model bird to balance (stay upright) even after you tilt it.* **MORE DETAILS** *Gravity* lesson or access in the SPIKE App
15 **PROMPT** **More with ELA**	**RESEARCH FOR WRITING** **CCSS.ELA-Literacy.W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.		• Research to learn about objects that are designed to prevent tipping. • Write the script for a video ad that tells why people should buy or use the	Provide learning materials about ways that varied objects, such as racing cars and drinking cups for babies, are designed to prevent tipping. Have students learn about one example and then share in writing, such as by developing a script for a video advertisement for a product.

		INFORMATIVE WRITING **CCSS.ELA-Literacy.W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information.	object.	**SAY** *Learn about objects, like racing cars and drinking cups for babies, that are designed to not tip. Then write the script for a video ad saying why people should buy or use the object.*

		Driving Around		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
16	**PROMPT** **More with Math and ELA**	**INFORMATIVE WRITING** **CCSS.ELA-Literacy.W.5.2.C** Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially). **CCSS.ELA-Literacy.W.5.2.D** Use precise language and domain-specific vocabulary to inform about or explain the topic. **GEOMETRY** **CCSS.MATH.Content.5.G.A.1-2** Graph points on the coordinate plane to solve real-world and mathematical problems.	• Measure distances on a route in order to create a gridded map. • Use precise language to write accurate directions from one place to another. • Use transition words to link ideas by sequence or spatial relationships. • Build and program a robotic vehicle to follow a route.	Have students dictate or write directions from the classroom to another part of the school, such as the cafeteria or the playground, or from one part of the classroom to another. Then prompt students to try the directions, measuring and determining details for accuracy such as how far down the hall, how many footsteps to take, and which way to turn. Ask them to transfer their route to a gridded map that shows *exactly* how far to go and when to turn, so that a robot can use it to navigate the school. If you wish, prompt them to build and program a robot to follow the directions. **SAY/ASK** *What's the way from our classroom to the cafeteria or playground? Write some directions to one of these places or another at school. Then try the directions, measuring and adding details for accuracy. How far "down the hall"? How many footsteps until I turn? Which way do I turn? Transfer the route to a gridded map that shows these details, so that a robot can use the map to navigate the school.* ***Then try this>*** *Build a robot vehicle, using any of the models in the* Build *section of the LEGO® Education SPIKE™ App. Program it to navigate your directions.* **MORE DETAILS** Model directions in the Build *section of the LEGO® Education SPIKE™ App*, available on the web or downloaded
17 🕒🕒	**LESSON**	**COMPUTATIONAL THINKING** **CSTA 3-5 1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate. **DESIGN ENGINEERING** **NGSS 3-5 ETS1-2** Generate and compare multiple possible solutions to a problem	• Compare different ways to program the motor blocks to determine which is more efficient.	Have students build the *Taxi! Taxi!* model from the Build section of the LEGO® Education SPIKE™ App. Then ask them to program the model to navigate town in the taxi. Prompt them to try programming each motor with Motor Blocks + More Motor Blocks and then to try using More Movement Blocks to control both motors at once. (As needed, show students how to access the menu of Extension blocks from the + at lower left of the programming canvas.) Have students

		based on how well each is likely to meet the criteria and constraints of the problem.		compare the two coding approaches to determine which is more efficient–fewer blocks, faster/easier for results–to code. **SAY/ASK** *Build a driving car using directions for the* Taxi! Taxi! *lesson. Then program it to navigate your town. Try programming the two motors in two different ways. First, use Motor Blocks and More Motor Blocks to program each one. Then use More Movement blocks to control both motors at once. Which approach is easier? Faster? Works best?* **MORE DETAILS** *Motor Blocks*, *More Motor Blocks*, and *More Movement Blocks* in the Help section of the LEGO® Education SPIKE™ App, available on the web or downloaded; (Access the menu of Extension (More...) Blocks from the + at lower left of the programming canvas.)
18	**PROMPT** **More with Math**	**GEOMETRY** **CCSS.MATH.Content.5.G.A.1** Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).	• Use a coordinate grid to create a map of places to visit. • Program a model car to move from one place to another on the map.	Have students extend their mapping to use a coordinate grid for a map of places to visit in the community. Direct them to place the school at point (0,0) and LEGO® bricks at various other locations as points on the map. Ask students to record the coordinates for each point and then program the driving car (*Taxi! Taxi!* model) to move from point to point. **SAY** *Make a map of the community for the car model to use. Put school at (0,0) on a coordinate grid. Then place LEGO® bricks at different parts of the grid to represent other locations, like the park or grocery store. Record coordinates for each of these points and program the car model to move from one to another.*

	**Big Little Helper**			
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
19 🕒 🕒	**LESSON**	**DESIGN ENGINEERING** **NGSS 3-5 ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	• Create a possible solution to a problem that has constraints. • Improve on others' ideas to develop a new program.	Have students use build a robot to help Daniel take his things home from school. Then have them program the robot to follow Daniel on his route home. **SAY/ASK** *Daniel's locker is overflowing. He needs to clean it out and take things home. How can he get all his things*

		COMPUTATIONAL THINKING **CSTA 3-5 1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate.	• Engage effectively in a range of collaborative discussions.	*home? Build him a robot helper and program it to follow Daniel on his route home.* **MORE DETAILS** *Big Little Helper* lesson or access in the LEGO® Education SPIKE™ App
20 🕒	**PROMPT** **More with Computer Science**	**IMPACTS OF COMPUTING** **CSTA 3-5 1B-AP-19** Brainstorm ways to improve the accessibility and usability of technology products for the diverse needs and wants of users. **DESIGN ENGINEERING** **NGSS 3-5 ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem	• Identify ways to use programming to increase accessibility for users. • Rebuild and program a robot helper that can carry two people.	Lead discussion about why it's important for technology to meet users' needs, such as to increase accessibility for people that use wheelchairs. Have students rebuild and reprogram Daniel's robot helper so that it can carry Daniel and a friend to the playground. **SAY/ASK** *Daniel wants all his friends to be able to use his robot helper. Rebuild and program a new helper that can carry Daniel and a friend to a new playground. Make sure your new robot helper meets the needs of both Daniel and his friends.*
21 🕒	**PROMPT** **More with Math**	**GEOMETRY** **CCSS.MATH.Content.5.G.A.1** Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).	• Create a coordinate system of graph points to create a map for a robot helper.	Have students use graph points to map the robot helper's path. They should use the x- and y-axis to plot where the robot helper travels. They can also plot the path of another group's helper. **SAY/ASK** *Make a map of the robot helper's path. Use x- and y-axis to plot where the robot travels.* ***Then try this>*** *Plot the path of another group's helper.*

	**High-Tech Playground**			
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
22 🕒	**PROMPT** **Meet the Light Matrix**	**SEQUENCES** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.	• Investigate the Light Matrix. • Use word blocks to create sequences using the Light	Introduce the Light Matrix to prepare students for using it in *High-Tech Playground*. Prompt them to program the Light Matrix to show light patterns. Invite them to share.

		COMPUTING SYSTEMS **CSTA 3-5 1B-CS-01** Describe how internal and external parts of computing devices function to form a system.	Matrix. • Use appropriate terminology when using hardware and software.	**SAY** *Maria wants to make her playground more exciting. Get ready to help her by exploring ways to use the Light Matrix. Plug the Light Matrix into the hub and try programming it with word blocks to make light patterns. Show your patterns to other groups.* **MORE DETAILS** *The Light Matrix* tutorial in the START section of the LEGO® Education SPIKE™ App, available on the web or downloaded.
23 LESSON	LESSON	**DESIGN ENGINEERING** **NGSS 3-5 ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **MODIFY PROGRAMS** **CSTA 3-5 1B-AP-12** Modify, remix, or incorporate portions of an existing program into one's own work, to develop something new or add more advanced features.	• Use the design process to improve an existing object. • Develop, test, and refine prototypes as part of a design process. • Engage effectively in a range of collaborative discussions.	Have students build and program a fun seesaw for the playground. Ask them first to program it to rock. Then ask them to make it more exciting for Maria and her friends, perhaps by using the Light Matrix to add light patterns. **SAY/ASK** *Maria is disappointed. There isn't anything for her and her friends to play on during recess. How could they add high-tech features to make the playground more fun? Help Maria design something for her friends! Start with a seesaw and then improve it to be more exciting. What about adding a light show with the Light Matrix?* **MORE DETAILS** *High-Tech Playground* lesson or access in the SPIKE App
24 PROMPT **More with Math**	PROMPT **More with Math**	**PATTERNS AND RELATIONSHIPS** **CCSS.MATH.Content.5.OA.B.3** Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.	• Develop a numerical pattern. • Program a seesaw model to move according to the numerical pattern.	Prompt students to create a pattern in the movement of the seesaw, using numerical patterns such as starting at 0 and then adding 2. Have them pick a pattern to program the movement of the seesaw. For example, it would move 2 times, then pause, then move 4 times, then pause, then 6 and so on. **SAY/ASK** *Think about the way a seesaw moves up and down. What could make that more exciting? Create a numerical pattern, such as starting at 0 and adding 2. Brainstorm some ideas, then choose one and program the movement of the seesaw to reflect it.*
25 PROMPT **Meet the Color Sensor**	PROMPT **Meet the Color Sensor**	**DATA & ANALYSIS** **CSTA 3-5 1A-DA-06** Organize and present collected data visually to highlight relationships and support a claim.	• Use the Color Sensor and word blocks to create a line graph that shows the colors detected by the	Have students explore ways to create a line graph. Staring with the original program to move the seesaw model up and down, have students add the line graph programming block to create a graph of the acceleration of the motor.

		MODIFY PROGRAMS **CSTA 3-5 1B-AP-12** Modify, remix, or incorporate portions of an existing program into one's own work, to develop something new or add more advanced features. **MATH SKILL PRACTICE: LINE GRAPHS** Extend the *High-Tech Playground* lesson.	Sensor.	**SAY/ASK** *Create a line graph to show the acceleration of the motor.*  **MORE DETAILS** *Sensor* and *Log and Visualize Data Over Time Blocks* in the Help section of the LEGO® Education SPIKE™ App, available on the web or downloaded. (For connection steps, review *The Color Sensor* tutorial in the START section.)
26 🕒	**PROMPT** **More with ELA**	**INFORMATIVE WRITING** **CCSS.ELA-Literacy.W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. **CCSS.ELA-Literacy.W.5.1.B** Provide logically ordered reasons that are supported by facts and details.	• Write an opinion piece with a clearly stated argument. • Use reasons, facts, and details to effectively support the opinion.	Have students write an opinion piece on whether there should be a playground at their school. Make sure that they give a clear argument supported by reasons, facts, and details. **SAY/ASK** *Should there be a playground at your school? Why or why not? Write an opinion piece to say what you think. Include a clearly stated opinion. Support it with reasons, facts, and details.*

Daytime and Nighttime

#	Activity Name	TOPIC(S) & Standards	Objectives Students will	Prompt
27 🕒 🕒	**LESSON** **Part A**	**SOLAR SYSTEM; PLANETS** **NGSS 5-ESS1-2** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. **COMPUTATIONAL THINKING** **CSTA 3-5 1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended. **DESIGN ENGINEERING** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that	• Use provided data to find monthly patterns in the hours of daylight for a location. • Present the data in graphical form. • Create a model of a campsite light that turns on at night and turns off during the day. • Revise a model and program to improve its performance	Have students build an overhead lamp to illuminate the path in Sofie's campsite at night when it's dark. Lead discussion about how long it should be on this time of year. Then share the provided data (see Prepare in the lesson) and assign each group a month. Explain that students should use the data to 1) show the average number of local daytime and/or nighttime hours per month on a line graph or on a series of pie charts and 2) identify the number of hours of nighttime (darkness) in the month you've assigned them. Finally, have students use their graphed data to program their overhead lamp to light the path at night when it's dark. **SAY** *Sofie wants to light the path near her campsite for safety. Help her set an overhead lamp to be on at night when it's dark. Start by creating a line graph or series of pie*

		includes specified criteria for success and constraints on materials, time, or cost. **NGSS 3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		*charts of daytime and nighttime hours where you live. Use the data to program your light to light the path when it's dark in your assigned month.* **More Details** *Daytime and Nighttime* lesson or access in the LEGO® Education SPIKE™ App
28 **Lesson** **Part B**				Have students add a path and trees to expand Sofie's campsite. Then have them test their model and program to make sure the lamp illuminates the path at night when it's dark. Prompt them to change the model and/or program to improve how the lamp performs and test again. **Say** *Now add to your campsite, such as with a path and trees. Test your model lamp and program it to light the path when it's dark at night. Revise the program and/or the model to improve the lamp and then test again.* **More Details** *Daytime and Nighttime* lesson or access in the SPIKE App
29 **Prompt** **More with Math**		**Math Skill Practice: Comparing Data** **Model with mathematics** **CCSS.MATH.Practice.K-12.MP.4** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. **Measurement and Data: Converting** **CCSS.MATH.Content.5.MD.A.1** Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.	• Graph hours of daylight and darkness in a specified location. • Compare hours of daylight and darkness in two locations.	Have students graph daytime and nighttime data for another city, either one closer to the equator or closer to one of the poles and then compare this new location to the provided local data. (As needed, see the lesson for recommended sources of additional data.) Guide students to show all the data in their comparison into the same units, e.g., minutes or hours, and to convert as needed. **Say/Ask** *What if Sofie's campsite were in a different place? Graph daytime and nighttime data for another city that is closer to the equator or one of the poles. Compare this location to your local data. What is different? The same? Make sure to use the same units, like minutes or hours, in all your data. Convert if you need to.*

	**Trash Monster Machine**			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**

30	**PROMPT** **More with the Color Sensor**	**DATA & ANALYSIS** **CSTA 3-5 1A-DA-06** Organize and present collected data visually to highlight relationships and support a claim. **MATH SKILL PRACTICE: BAR GRAPHS** Prepare for the *Trash Monster Machine* lesson.	• Use the Color Sensor and word blocks to create a bar graph that shows the colors detected by the Sensor.	To prepare for the *Trash Monster Machine* lesson, have students explore ways to create a bar graph. Prompt them to plug the Color Sensor into the hub and create a program that will track the different colors detected in a bar graph. **SAY/ASK** *Practice using the Color Sensor to control aspects of your program. Plug it into your hub. Create a program that will track the different colors that the Sensor detects on a bar graph. (Use Bar Graph Blocks.)* **MORE DETAILS** *Sensor* and *Bar Graph Blocks* in the Help section of the LEGO® Education SPIKE™ App, available on the web or downloaded. (For connection steps, review *The Color Sensor* tutorial in the START section.)
31	**LESSON**	**DESIGN ENGINEERING** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. **DEVELOP PROGRAMS** **CSTA 3-5 1B-AP-13** Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences.	• Explore the benefits of automated solutions. • Refine a prototype as part of a cyclical design process. • Engage effectively in a range of collaborative discussions.	Have students build Sofie a machine to collect trash at her school. Then prompt them to program it so everyone at school will want to use it for all kinds (colors) of trash. If you wish, have students use the Bar Graph blocks in their SPIKE App to count trash. **SAY/ASK** *Sofie has noticed that some of her friends don't throw out their trash after lunch. Help Sofie create a new way for her friends to throw out their trash. What could make everyone want to use the machine? Design, build, and program a machine to collect all the trash at school, no matter what color it is. Then improve it to work even better. Try using Bar Graph blocks to graph the colors.* **MORE DETAILS** *Trash Monster Machine* lesson or access in the SPIKE App; *Bar Graph Blocks* in the Help section of the App, available on the web or downloaded.
32	**PROMPT** **More ELA and Computer Science**	**INFORMATIVE WRITING** **CCSS.ELA-Literacy.W.5.9.B** Apply grade 5 Reading standards to informational texts (e.g., "Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point[s]"). **READING INFORMATIONAL TEXTS** **CCSS.ELA-Literacy.RI.5.9** Integrate information from several texts on the same	• Research in several texts to learn about ways countries sort and dispose of trash. • Integrate information from research to redesign and reprogram a model.	Have students conduct a short research project comparing how two different countries sort and dispose of their trash. Prompt them to use the information to redesign and program their trash monster to meet the needs of a country that they researched. **SAY** *Research to learn how two countries sort and dispose of trash. Use the information to redesign and program your trash monster machine to meet the needs of people in one of the two countries.*

		topic in order to write or speak about the subject knowledgeably. **SEQUENCES/LOOPS** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.		

	**Protect the Environment**			
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
33 🕒🕒	**LESSON** **Part A**	**EARTH AND HUMAN ACTIVITY** **NGSS 5-ESS3-1** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. **COMPUTATIONAL THINKING** **CSTA 3-5 1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended. **DESIGN ENGINEERING** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	• Identify at least two sources for research. • Use research to describe one way that individual communities use science ideas to protect the environment. • Create a model of their chosen community action.	Lead students in discussing and identifying actions they can take in the community to care for the environment. Then have students begin to build and program a model of their chosen community action, using the provided base model for inspiration if they wish. **SAY/ASK** *Leo takes good care of Spike Town. How can you care for the environment in your community? Learn about some ways other people are already doing this. Choose one. Show your learning by building and programming a model. Get started and you'll finish in the next activity.* **MORE DETAILS** *Protect the Environment* lesson or access in the LEGO® Education SPIKE™ App
34 🕒🕒	**LESSON** **Part B**			Have students continue to build and program their model of a community action. **SAY** *Keep working on your model of community action. Try to show what you learned from research.* **MORE DETAILS** *Protect the Environment* lesson or access in the App
35 🕒	**PROMPT** **More with ELA**	**RESEARCH FOR WRITING** **CCSS.ELA-Literacy.W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.	• Research to learn about ways that communities use science to protect Earth's resources and environment. • Create a short oral presentation or poster of their findings.	Have students research another way in which individual communities use science to protect Earth's resources and environment. Have them share their findings through a short oral presentation or poster. **SAY** *Research ways that* other *communities protect Earth's resources and environment. Share your learning findings through a short oral presentation or poster.*

	**Energy Flow**			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
36	**Lesson**	**Energy Transfer and Transformation** **NGSS 5-PS3-1** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. **Computational Thinking** **CSTA 3-5 1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended. **Design Engineering** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	• Create a model that accurately shows the flow of energy from sunlight to plants and then to animals. • Use their model to describe how animals get and use energy from the sun. • Use their model to explain that energy in animals' food was once energy from the sun.	Have students build and program a model to help the team learn about the relationship between the sun's light and animal growth. Models should show the flow of energy and demonstrate how animals get and use energy from it. **Say/Ask** *Daniel, Maria, Leo, and Sofie know that plants use sunlight to grow bigger. Do animals also need it to grow bigger? Build a model to show the team the relationship between sunlight and animal growth.* **More Details** *Energy Flow* lesson or access in the LEGO® Education SPIKE™ App
37	**Prompt** **More with ELA**	**Research for Writing** **CCSS.ELA-Literacy.W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.	• Research to learn about ways that humans use energy from the sun to meet their needs.	Have students research a way that humans use energy from the sun to meet their needs. To prompt students' thinking, lead brainstorming or share ideas such as solar panels to make electricity or passive solar design to warm homes. **Say/Ask** *What are some ways that people use energy from the sun to meet their needs? Identify some and research to learn about them.*

	**Winning Goal**			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
38	**Prompt** **More with Math**	Prepare to create bar graphs in the *Winning Goal* lesson. **Math Skill Practice: Bar Graphs** **CCSS.MATH.Practice.K-12.MP.5** Use appropriate tools strategically.	• Use programming tools to show data in bar graph form.	To prepare students for *Winning Goal*, have them practice using the Bar Graph feature in the SPIKE App. Prompt them to use the Bar Graph Blocks to graph data of their choosing or that you supply.

		Data & Analysis **CSTA 3-5 1A-DA-06** Organize and present collected data visually to highlight relationships and support a claim.		**Say/Ask** *Practice using the Bar Graph feature in your SPIKE App more. What else can it do? How can you use it to graph data? Try some different ways. Share with the class.* **More Details** *Bar Graph Blocks* in the Help section of the LEGO® Education SPIKE™ App, available on the web or downloaded.
39 **Lesson**		**Design Engineering** **NGSS 3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. **Computational Thinking** **CSTA 3-5 1B-AP-11** Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process.	• Identify the failure points of a model or program. • Consider failure points in order to make improvements. • Engage effectively in a range of collaborative discussions.	Lead discussion about what makes computer games fun. Have students build a soccer game for Maria, applying some of the ideas generated by brainstorming. Prompt them to program the game to move the goal, iterating to find even wackier ways to move it around. **Say/Ask** *Maria isn't having fun playing soccer. She prefers the wackiness of her computer games. How can Maria's soccer game be more like a computer game? Brainstorm ideas. Then build and program a game for Maria. Make it move the goal around. See how much fun you can add!* **More Details** *Winning Goal* lesson or access in the SPIKE App
40 **Prompt** **More with Math and Computer Science**		**Math Skill Practice: Using Graphs** **CCSS.MATH.Practice.K-12.MP.5** Use appropriate tools strategically. **Data & Analysis** **CSTA 3-5 1A-DA-06** Organize and present collected data visually to highlight relationships and support a claim.	• Program to create a bar graph of points scored in a game.	Prompt students to add the Color Sensor to the goal machine and create a graph of the points scored. Each time a goal is scored students can hold up a brick to the sensor to keep points. As needed, show students how to include the Bar Graph extension in their programming blocks. (Available by clicking the small + at lower left of the programming canvas.) **Say/Ask** *Add the Color Sensor to your model and program it to count the points scored on Maria's machine. Hold up a brick to keep points. Then make a bar graph of the data in your SPIKE App. You'll need to add the Bar Graph extension to your blocks. See the small + at the bottom left of the programming canvas.* **More Details** *Bar Graph Blocks* in the Help section of the SPIKE App, available on the web or downloaded.
41 **Prompt** **More with ELA**		**Writing** **CCSS.ELA-Literacy.W.5.4** Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.	• Write a sports commentary about the soccer game they built. • Use domain-specific sports terminology and	Have students write a sports commentary for Maria and Sofie's soccer game. Make sure that they use correct sports terminology and directional vocabulary.

		CCSS.ELA-Literacy.W.5.2.D Use precise language and domain-specific vocabulary to inform about or explain the topic.	directional vocabulary to clearly explain how the game works.	**SAY/ASK** *Do you think people would like the game you made? Write a commentary about it for sports lovers. Use sports terms and directional vocabulary to clearly explain how the game works.*

	**Literary Randomizer**			
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
42 	**LESSON**	**DESIGN ENGINEERING** **NGSS 3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **SEQUENCE/LOOPS** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.	• Define success criteria to help evaluate a solution. • Compare and contrast different solutions to determine which one meets the specified need. • Engage effectively in a range of collaborative discussions	Have students build a machine to help Daniel decide what kind of books to read. Brainstorm some genres of books, like mysteries, how-to, and science fiction. After they build the machine, prompt students to program it to select book genres randomly. **SAY/ASK** *Daniel can't decide which book to read. He feels overwhelmed by all the books in the library. How can Daniel's literary randomizer make picking a book more exciting? Build a machine for him. Program it to choose the kind of book randomly and surprise Daniel! He can try many kinds of books to choose the ones he likes best.* **MORE DETAILS** *Literary Randomizer* lesson or access in the LEGO® Education SPIKE™ App
43 	**PROMPT** **More with Math**	**NARRATIVE WRITING** **CCSS.ELA-Literacy.W.5.3** Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.	• Write narrative stories with the specific features of selected genres.	Have students write stories based on the fiction genres chosen by their literary randomizers. Lead brainstorming into the features of some familiar fiction genres, like mystery and science fiction. Make sure that students use narrative techniques, such as dialogue and description, to create a story that fits the genre. **SAY/ASK** *Think of all the different stories that could be in books Daniel reads. For example, science fiction stories are very different than mysteries. Choose a few kinds of stories as your model. What is the dialogue like? What is the description like? Write some new stories that use the features of your chosen type of story.*

	**Your School Creation**			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
44 🕒🕒🕒	**Lesson**	**Design Engineering** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. **NGSS 3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **NGSS 3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. **Computational Thinking** **CSTA 3-5 1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate. **CSTA 3-5 1B-AP-11** Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process. **Sequence/Loops** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Develop Programs** **CSTA 3-5 1B-AP-13** Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences. **CSTA 3-5 1B-AP-17** Describe choices made during program development using code comments, presentations, and demonstrations.	• Apply engineering design skills in order to solve a problem. • Practice brainstorming as part of the design process. • Engage effectively in a range of collaborative discussions.	Have students consolidate their learning from the *Quirky Creations* activities to design, build, and program a model that will help the Spike Team during the school day. **Say** *The team thinks there's a way to bring a new creation to their classroom. It's time to create your very own invention for the team's classroom! Use at least one motor or sensor!* **More Details** *Your School Creation* lesson or access in the LEGO® Education SPIKE™ App

		MODIFY PROGRAMS **CSTA 3-5 1B-AP-12** Modify, remix, or incorporate portions of an existing program into one's own work, to develop something new or add more advanced features.		
45 🕒	**PROMPT** **More with ELA**	**INFORMATIVE WRITING** **CCSS.ELA-Literacy.W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information.	• Write an advertisement for the school creation models the class has built. • Include an opinion on which one is the best creation. • Include reasons and information to support your opinion.	Have students create advertisements for their new school creations. They should include an opinion on why their creation is the best one for the team's classroom. **SAY/ASK** *Think about all the creations the class designed. Which one is the best? Create an ad for some or all the creations. Include an opinion on why your creation is the best one. Support the opinion with information and reasons.*

		Build to Launch		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
46 🕒	**PROMPT** **Mission Briefing: Getting to Space**	**ELA SKILL PRACTICE: SEQUENCE AND SPATIAL LANGUAGE** **CCSS.ELA-Literacy.W.5.1.2.C** Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially).	• Use sequence and spatial language to write clear directions for moving from one place to another.	Introduce students to the LEGO® Space team and NASA's Artemis I Mission. Share an overview of the 10-week digital series and the first assignment. Have students first think about moving objects and write directions for moving one to someplace new in the school. Then ask pairs to test each other's directions (without the object) to each new place. **SAY** *Think about moving objects. Write directions for moving an object in the classroom to another place in the school, like another classroom or the gym or the front door. With a partner, test your directions to reach the new place.* **MORE DETAILS** Build to Launch - NASA's Artemis Mission; Teacher Resource Guide; Getting to Space Module 1 Resources Download Module 1 Teacher Guide to find *Mission Briefing: Getting to Space.*
47 🕒 🕒	**LESSON** **Misson: Operation Autopilot**	**DESIGN ENGINEERING** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	• Design and build a prototype of an autonomous vehicle similar to a planetary rover. • Investigate autonomous	Guide students to explore the importance of autonomous technology in space. Have them design and build a vehicle that can move independently and complete specific tasks on the lunar surface. Share background, such as that a signal

		SEQUENCE/LOOPS **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.	movements.	from Earth to Mars could take 14 minutes to reach the vehicle and another 14 minutes to get back. **SAY/ASK** *Think about driving a remote-controlled car that is far, far away. Signal could take a very long time to go back and forth. Also, the surface of the Moon and other planets have rocks, sand, and other obstacles that can cause a vehicle to get damaged or stuck. Create, build, and program a vehicle that can drive itself.* **MORE DETAILS** Getting to Space - Module 1 Resources Download the Module 1 Teacher Guide to find *Mission: Operation Autopilot.*
48	**PROMPT** **More with Math**	**MATH SKILL PRACTICE: MEASUREMENT**	• Measure the distance of a wheel's rotation. • Describe distances in terms of rotations.	Have students explore programming a remote vehicle ahead of time (Review that the communication time lag won't allow for real-time control of the vehicle). Guide them to measure the distance of one rotation of the vehicle's wheel(s), and then use multiplication to find the number of such rotations needed to drive to different places on the Moon or a planet. **SAY/ASK** *Explore ways to program that far away remote-controlled car. Remember that the time lag won't allow you to control it in real time. You must program everything ahead of time. Measure the distance of one rotation of the vehicle's wheel(s). Then describe distances in terms of rotations. How many rotations of the wheel does it take to get to places on the Moon or a planet?*
49	**LESSON** **Mission: STEAM Work is Teamwork**	**DESIGN ENGINEERING** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. **DEVELOP PROGRAMS** **CSTA 3-5 1B-AP-16** Take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development.	• Plan and design a Space Launch System rocket to be built in sections. • Build a section of a spacecraft. • Work together to assemble all parts of the spacecraft.	Introduce the essential importance of communication and planning in assembling a spacecraft whose parts are built by many independent groups. Use the Space Launch System example to show students how critical teamwork is to ensure that things go smoothly, and then prompt them to build their own prototype Space Launch System. **SAY/ASK** *Think of a time that you worked with someone else person to accomplish a task. Did you work together on all parts of the task? Or did you each take a part of the task to complete and then put the parts together to finish it? NASA often works in specialized teams to complete large tasks. Each team does a piece of the task based on their area of specialty and then all the teams put their pieces together.*

				Try it by working together to assemble a prototype Space Launch System. **More Details** Getting to Space - Module 1 Resources Download the Module 1 Teacher Guide to find *Mission: STEAM Work is Teamwork.*
50 **Prompt** **Mission Briefing: Testing and Transport**		**Design Engineering** **NGSS 3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	• Engage students in thinking about why testing an idea is important. • Ignite a discussion with students about testing.	Introduce students to life on the International Space Station and its complexities. Recap learnings from Module 1 "Getting to Space" and showcase student prototypes from its missions. Then share instructions for the next challenge. Emphasize the importance of testing an idea and share the example of creating the best paper airplane. Lead discussion in how to test their paper airplane design ideas. Allow students to create and test their design, reminding them not to change their ideas, only to test each several times. **Say/Ask** *As we get ready to explore life on the International Space Station, think about all the problems that must be solved to make it work. What are some ways to test solutions? Let's try it with paper airplane designs. Design a paper airplane and then test your ideas several times* without *changing the airplane itself.* **More Details** Testing and Transport - Module 2 Resources Download the Module 2 Teacher Guide>*Mission Briefing Testing and Transport*
51 **Lesson** **Mission: Building a Bullseye**		**Design Engineering** **NGSS 3-5-ETS1-3** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. **Computational Thinking** **CSTA 3-5 1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate.	• Design and build a device to reach a target. • Examine the importance of testing and iterating.	Have students investigate the need for thorough testing and precision when it comes to space travel. Share some background about the sophisticated guidance systems that NASA uses so spacecrafts reach their destinations, and the testing used to ensure everything works as intended. Then, prompt students to apply these ideas to design and build a device that can aim and move toward a target. **Say/Ask** *Why might it be important to test everything for use in space? For example, what could happen if measurements aren't precisely correct? Use thorough testing and precision to design and build a device that can aim and move toward a specific target.* **More Details** Testing and Transport - Module 2 Resources Download the Module 2 Teacher Guide to find *Mission: Building a Bullseye.*

52	PROMPT **More with Math**	**GEOMETRY** **CCSS.MATH.Content.5.G.A.1** Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).	• Create a coordinate plane on which to map at least two points. • Use their device design to practice moving from point to point.	Have students create a coordinate plane and select two points. Students will need to practice hitting their mark using their design from Mission: Building a Bullseye to move from point to point. Provide several sets of points to plot on the large coordinate plane. **SAY** *Create a coordinate plane and select two points on it – one is the bullseye. Use your design from Building a Bullseye or any vehicle you can program, to practice moving from point A to the bullseye at point B.*
53	LESSON **Mission: The Path to the Pad**	**DESIGN ENGINEERING** **NGSS 3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **COMPUTATIONAL THINKING** **CSTA 3-5 1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate.	• Design and build a transport vehicle. • Investigate how to move large and heavy objects.	Introduce students to how NASA moves an entire rocket to the launchpad. Then prompt them to design and build a prototype vehicle that can move large, heavy objects easily. **SAY/ASK** *Think about a time you had to move something really large. Was it easy to do? What did you need to help them move it? Now imagine having to move a rocket and a launchpad. Design and create a device that can lift and move large objects like a rocket safely. How will you control the movements of the device to ensure the objects they are transporting are not damaged?* **MORE DETAILS** Testing and Transport - Module 2 Resources Download the Module 2 Teacher Guide to find *Mission: The Path to the Pad.*
54	PROMPT **More with Math**	**MEASUREMENT AND DATA: VOLUME** **CCSS.MATH.Content.5.MD.C.4** Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.	• Use LEGO® bricks as the unit to measure the volume of a container.	Prompt students to carry a bucket or other container on their transport devices. Have them measure the volume of the container in LEGO® bricks. **SAY/ASK** *How large of an object can your transport device carry? Put a bucket or other container on it. Measure the volume in LEGO bricks. How many bricks will fit?*
55	PROMPT **Mission Briefing: Working in Space**	**RESEARCH FOR WRITING** **CCSS.ELA-Literacy.W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.	• Engage students in thinking about what barriers exist to working in space. • Ignite a discussion with	Introduce students to the James Webb Space Telescope launch. Review concepts and showcase student prototypes from Module 2 "Testing and Transport." Then discuss some challenges of working in space and brief students on their next missions. To prepare for those missions, ask students to

			students on what they think it is like to work in space.	research to investigate the barriers that must be overcome to work in space. Prompt them to identify several obstacles and how we currently overcome them. **SAY** *Before our next mission, explore some challenges of working in space. Use research to learn about them and then think about how we currently solve them. Write your ideas about how easy or hard it might be to work in space.* **MORE DETAILS** Working in Space - Module 3 Resources Download the Module 3 Teacher Guide to find *Mission Briefing: Working in Space.*
56 🕒🕒🕒	**LESSON** **Mission: Staying Safe in Space**	**DESIGN ENGINEERING** **NGSS 3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. **COMPUTATIONAL THINKING** **CSTA 3-5 1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate.	• Design and build an alert system. • Investigate safety needs in space	Have students extend their learning from the previous activity to consider hazards in space, learn how spacecraft and equipment are built to protect against them, and design and build an alert system to ensure a safe mission. **SAY** *Think about ways we're warned of danger on Earth, like with fire alarms. Astronauts face other dangers, like radiation from solar energy particle storms. Design, build, and program a model that will alert the astronauts that there is danger. What sort of device should it be? Use ideas from alarms you've seen on Earth. Consider adding sounds, lights, movement. Make sure your alarm will get everyone's attention and tell the astronauts the most important information they need.* **MORE DETAILS** Working in Space - Module 3 Resources Download the Module 3 Teacher Guide to find *Mission: Staying Safe in Space.*
57 🕒🕒🕒	**LESSON** **Mission: The Right Tool for the Job**	**DESIGN ENGINEERING** **NGSS 3-5-ETS1-2** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **DEVELOP PROGRAMS** **CSTA 3-5 1B-AP-13** Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences.	• Design and build a tool that can be used in space. • Investigate needs for tools in space. • Compare completing tasks in space to on Earth. • Think about how scientists design tools to use in space	Have students examine the physical work astronauts do and the unique tools they use. Then prompt them to design and build a suitable tool for use in space. **SAY/ASK** *Think about tools you use to complete different jobs, like a shovel to dig a hole or a pencil to write a letter. Astronauts use specialized tools too, such as to repair a spacecraft. What types of tools might astronauts use in a spacecraft or to explore the surface of the Moon or Mars? Design and build a tool for astronauts to use. Think about the task you are designing for and what the tool needs to do. What features does the tool need to accomplish this task? What features will you include in your tool?*

				MORE DETAILS Working in Space - Module 3 Resources Download the Module 3 Teacher Guide to find *Mission: The Right Tool for the Job.*
58 	**PROMPT** **Keeping Information Safe**	**CYBERSECURITY** **CSTA 3-5 1B-NI-05** Discuss real-world cybersecurity problems and how personal information can be protected.	• Design and build a container to keep data safe. • Use sensors and hardware to create a physical password with at least three steps.	Share with students that just as it's important to keep the astronauts safe in space, it's also important to keep information safe. Prompt students to create a physical password using the different sensors and hardware available in their LEGO® Education SPIKE™ App and set. Explain that the password must include three steps. If you wish, increase the difficulty by allowing students to build something like a safe that symbolizes the protection of the data. **SAY/ASK** *We've seen why it's so important – and sometimes difficult – to keep astronauts safe in space. How can we keep information safe too? Use the sensors and hardware in your SPIKE set to create a physical password with three steps.* ***Then try this>*** *Build a container, like a safe, to hold the "data."*