LEGO® Education

STEAM Learning Progression

SPIKE™ Prime Grade 8

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™ Prime. 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 *Data & Analysis* or *CSTA*.
- ☑ 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

MORE DETAILS Links that lead to lesson details and teaching support

PROMPT Short activities to quickly expand or extend the learning

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*
- ☑ *LEGO® Education SPIKE™ Prime FAQs*
- ☑ *LEGO® Education SPIKE™ Prime Resources – Download vs. Streaming*
- ☑ *LEGO® Education SPIKE™ Prime - Computer Science Courses*

#	Activity Name	Topic(s) and Standards	Objectives Students will	Prompt
1	PROMPT **Back to Back**	**Skill Practice: Design engineering, Decomposing a Problem, Sequence of Events**	• Investigate what makes a sequence by practicing following step-by-step instructions. • Understand the importance of clear steps and directions. • Follow agreed-upon rules for collaborative work. •	Use a simple follow-the-steps activity to introduce students to sequencing and the importance of working collaboratively. Organize pairs and provide each with the same bricks. Prompt pairs to build the tallest tower they can in 5 minutes. Then prompt them to build a second tower, taking turns adding to the tower, but **not** talking to each other. Lead discussion about why the second task is harder. If you wish, have students exchange verbal building directions. **Say/Ask** *With your partner, build the tallest tower you can in 5 minutes. Now build another tower. Take turns adding to it. But don't talk to each other! What was different? Why?* ***Then try this>*** *Give your partner step-by-step building directions to create a tower.*
2	PROMPT **Meet the Light Matrix**	**Computing Systems** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **Skill Practice: Sequence of Events**	• Follow instructions to create a program. • Explore programming the light matrix. • Describe coding steps in sequence.	Introduce students to the light matrix in their set as they prepare to program it. Using the Light Matrix tutorial, have students start with the hub. Then prompt them to describe the coding steps in words to a partner. **Say** *Turn on your hub. Follow the tutorial steps to make it work. Then tell your partner step by step what the code does. Say what happens in order.* **More Details** *The Light Matrix* tutorial in the START section of the LEGO® Education SPIKE™ App, available on the web or downloaded
3	PROMPT **Meet the Motor**	**Computing Systems** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **Skill Practice: Sequence of Events**	• Follow instructions to create a program. • Explore programming a motor. • Describe coding steps in sequence.	Introduce students to the motor in their set as they prepare to program it. Using the Motor tutorial, have students start the motor. Then prompt them to describe the coding steps in words to a partner. **Say** *Connect a motor to your hub. Follow the tutorial steps to make it move. Then tell your partner step by step what the code does. Say what happens in order.* **More Details** *The Motor* tutorial in the START section of the SPIKE App, available on the web or downloaded

4	**PROMPT** **Meet the Color Sensor**	**COMPUTING SYSTEMS** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **SKILL PRACTICE: SEQUENCE OF EVENTS**	• Follow instructions to create a program. • Explore programming a sensor. • Describe coding steps in sequence.	Introduce students to the color sensor in their set as they prepare to program it. Using the Color Sensor tutorial, have students start with the sensor. Then prompt them to describe the coding steps in words to a partner. **SAY** *Connect the color sensor to your hub. Follow the tutorial steps to make it work. Then tell your partner step by step what the code does. Say what happens in order.* **MORE DETAILS** *The Color Sensor* tutorial in the START section of the SPIKE App, available on the web or downloaded
5	**PROMPT** **Meet the Distance Sensor**	**COMPUTING SYSTEMS** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **SKILL PRACTICE: SEQUENCE OF EVENTS**	• Follow instructions to create a program. • Explore programming a sensor. • Describe coding steps in sequence.	Introduce students to the distance sensor in their set as they prepare to program it. Using the Distance Sensor tutorial, have students start with the sensor. Then prompt them to describe the coding steps in words to a partner. **SAY** *Connect the distance sensor to your hub. Follow the tutorial steps to make it work. Then tell your partner step by step what the code does. Say what happens in order.* **MORE DETAILS** *The Distance Sensor* tutorial in the START section of the LEGO® Education SPIKE™ App, available on the web or downloaded
6	**PROMPT** **Meet the Force Sensor**	**COMPUTING SYSTEMS** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **SKILL PRACTICE: SEQUENCE OF EVENTS**	• Follow instructions to create a program. • Explore programming a sensor. • Describe coding steps in sequence.	Introduce students to the force sensor in their set as they prepare to program it. Using the Force Sensor tutorial, have students start with the sensor. Then prompt them to describe the coding steps in words to a partner. **SAY** *Connect the force sensor to your hub. Follow the tutorial steps to make it work. Then tell your partner step by step what the code does. Say what happens in order.* **MORE DETAILS** *The Force Sensor* tutorial in the START section of the SPIKE App, available on the web or downloaded

7	PROMPT **Meet the Gyro Sensor**	**COMPUTING SYSTEMS** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **SKILL PRACTICE: SEQUENCE OF EVENTS**	• Follow instructions to create a program. • Explore programming a sensor. • Describe coding steps in sequence.	Introduce students to the gyro sensor in their set as they prepare to program it. Using the Gyro Sensor tutorial, have students start with the sensor. Then prompt them to describe the coding steps in words to a partner. **SAY** *Connect the gyro sensor to your hub. Follow the tutorial steps to make it work. Then tell your partner step by step what the code does. Say what happens in order.* **MORE DETAILS** *The Gyro Sensor* tutorial in the START section of the SPIKE App, available on the web or downloaded

		Stretch with Data		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
8	LESSON	**DESIGN ENGINEERING** **NGSS MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **EXPRESSIONS & EQUATIONS** **CCSS.MATH.CONTENT.8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. **FUNCTIONS** **CCSS.MATH.Content.8.F.A.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s2 giving the area of a square as a function of its side length is not linear because its graph contains the	• Create a program to be introduced to the LEGO® Education SPIKE™ Prime line graphing tool. • Graph real sensor data. • Correlate graph curves with real-life movement.	Have students match graph values and explore margins of error qualitatively using the pitch, roll and yaw of various movements with the yoga ring. **SAY/ASK** *How can we create a graph of our movements? Let's find out using the yoga ring.* **MORE DETAILS** *Stretch with Data* lesson or access in the LEGO® Education SPIKE™ App
9	PROMPT **More with Math and ELA**		• Communicate and express ideas clearly. • Create written or media artifacts to document learning.	Have your students use digital media to explain this lesson and their findings. They could do this by: ○ Producing a video ○ Posting pictures and comments via a learning management system (if available) ○ Contacting with a yoga instructor to research whether a device like the Yoga Ring model could be useful **SAY/ASK** *Create a way to share what you learned using media.*

		points (1,1), (2,4) and (3,9), which are not on a straight line. **SPEAKING & LISTENING** **CCSS.ELA-Literacy.SL.8.4** Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. **CCSS.ELA-Literacy.SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. **COMPUTING SYSTEMS** **CSTA 2-CS-01** Recommend improvements to the design of computing devices, based on an analysis of how users interact with the devices. **DATA & ANALYSIS** **CSTA 2-DA-09** Refine computational models based on the data they have generated.		

		This Is Uphill		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
10	**LESSON**	**PHYSICAL SCIENCE: ENERGY TRANSFER** **NGSS MS-PS3-4** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	• Perform an experiment that illustrates the transfer of energy, from electric to potential energy.	Have students graph energy consumption to gain potential energy by measuring the motor power of a bike going uphill. **SAY/ASK** *Let's see how we can record the movements of a bike moving on a hill. How does the hill affect the motor's power?* **MORE DETAILS** *This Is Uphill* lesson or access in the LEGO® Education SPIKE™ App

11	**PROMPTS** **More with Math and ELA**	**EXPRESSIONS & EQUATIONS** **CCSS.MATH.CONTENT.8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. **CCSS.MATH.CONTENT.8.EE.C.7** Solve linear equations in one variable. **CCSS.MATH.CONTENT.8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. **COMPUTING SYSTEMS** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **DATA & ANALYSIS** **CSTA 2-DA-09** Refine computational models based on data they have generated. **WRITING** **CCSS.ELA-LITERACY.W.8.2.A** Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.	• Communicate and express ideas clearly. • Create written or media artifacts to document learning.	Have each student write a science inquiry journal, documenting their hypothesis and conclusions as a scientist would or a newspaper article reporting a major new scientific discovery. Ask them to document the scientific protocols used, as a journalist would. Provide examples of scientific newspaper articles and science inquiry journals. Ask your students to compare the two and document their observations. **SAY/ASK** *Create write artifact that you might find documenting the process of scientific discovery.*

		Time for Squat Jumps		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
12 (2 clocks)	LESSON	**Physical Science: Energy Transfer** **NGSS MS-PS3-4** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. **Expressions & Equations** **CCSS.MATH.CONTENT.8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. **CCSS.MATH.CONTENT.8.EE.C.7** Solve linear equations in one variable. **CCSS.MATH.CONTENT.8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. **Computing Systems** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **Data & Analysis** **CSTA 2-DA-08** Collect data using computational tools and transform the data to make it more useful and reliable. **CSTA 2-DA-09** Refine computational models based on the data they have generated.	• Explore ways of measuring the height of a jump. • Use that value to calculate potential energy.	Have students graph potential energy at the maximum height of a jump. **Say/Ask** *How high can you jump? Let's measure to find out using our kettlebell.* **More Details** *Time for Squat Jumps* lesson or access in the LEGO® Education SPIKE™ App
13 (1 clock)	PROMPTS **More with Math and ELA**	• Investigate relationships in equations. • Conduct measurements to find real world data. • Discuss different ways to calculate potential energy and which methods are most efficient.	Instead of logging the distance between the bottom of the kettlebell and the ground directly with the distance sensor, ask students to use acceleration values to find the height of the jump. Have students use each method (measuring the distance and calculating it from acceleration values) to find the potential energy, and then to describe which method they found the hardest or the most efficient, and why. **Say/Ask** *There are different methods for finding the height of a jump. Let's explore which is the more efficient to use.*
14 (1 clock)		• Communicate and express ideas clearly. • Create written or media artifacts to document learning.	Ask students to write a paper explaining what happens when someone jumps. Have them research muscular strength and biomechanics, then compare human jump performance to that of several animals. Have your students investigate a robot prototype that can jump, then write a paper describing how its engineers have tried to replicate muscular impulse. **Say/Ask** *Let's document our learning by explaining what happens when someone jumps. Write a paper to explain how the human body works when jumping. Compare to other animals.*

		Watch Your Steps		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
15 🕒 🕒	LESSON	**Physical Science: Energy Transfer** **NGSS MS-PS3-4** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. **Expressions & Equations** **CCSS.MATH.CONTENT.8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. **CCSS.MATH.CONTENT.8.EE.C.7** Solve linear equations in one variable. **CCSS.MATH.CONTENT.8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. **Informational Writing** **CCSS.ELA-LITERACY.W.7.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. **CCSS.ELA-Literacy.W.7.2.A** Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g.,	• Learn to recognize the number of steps taken, as shown in an acceleration graph over time. • Convert step count into average speed and into average kinetic energy when walking.	Have students explore kinetic energy during a movement at constant speed. **Say** *Let's explore how we can use graph data to know how many steps we have taken.* **More Details** *Watch Your Steps* lesson or access in the LEGO® Education SPIKE™ App
16 🕒	PROMPTS **More with Math and ELA**	• Investigate ideal curves and what can affect them. • Discuss why rates might not be consistent.	Ask your students the identify the elements of their experiments that required approximation. Tell them to keep in mind that step lengths aren't always consistent and that pedometers have a limited rate of success (i.e., they're precise within a margin of error). Have students develop theoretical versions of their experiments by describing what ideal curve would describe a step. **Say/Ask** *Let's discuss the limitations of our pedometer and describe an ideal curve.*
17 🕒		• Communicate and express ideas clearly. • Create written or media artifacts to document learning.	Ask your students to research how smart watches or phones record step counts. Have them write a short explanation of how the technology works, including the percentage of error. Have your students explore how pattern recognition, from an AI point of view, helps these smart devices to detect steps. **Say/Ask** *How do your smart devices work to count your steps. Let's find out.*

		headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. **COMPUTING SYSTEMS** **CSTA 2-CS-01** Recommend improvements to the design of computing devices, based on an analysis of how users interact with the devices. **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **DATA & ANALYSIS** **CSTA 2-DA-08** Collect data using computational tools and transform the data to make it more useful and reliable.		

		Aim for It		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
18 L L L	**LESSON**	**PHYSICAL SCIENCE: ENERGY TRANSFER** **NGSS MS-PS3-4** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. **EXPRESSIONS & EQUATIONS** **CCSS.MATH.CONTENT.8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.	• Calculate initial speed for a decelerating movement from a graph showing the distance traveled over time. • Use this approximated speed to calculate the average kinetic energy.	Have student explore kinetic energy during a movement using variable speed using a curling rock. Students will push the model toward a target and trace a graph. **SAY** *How does kinetic energy work? Let's explore through graphing the movement of a curling rock.* **MORE DETAILS** *Aim for It* lesson or access in the LEGO® Education SPIKE™ App
19 L	**PROMPTS** **More with Math and ELA**		• Investigate how variables changing effects an equation. • Create graphs and compare results.	Have your students explore what happens when they change their curling rock's mass by adding elements (e.g., motors) or a heavy object (e.g., a water bottle). Ask them to update their models, rerun the experiment, and compare the graphs showing speed over time for the different masses. **SAY/ASK** *Let's investigate what happens when we change the mass of our curling rock.*

20		**CCSS.MATH.CONTENT.8.EE.C.7** Solve linear equations in one variable. **CCSS.MATH.CONTENT.8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. **INFORMATIONAL WRITING** **CCSS.ELA-LITERACY.W.7.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. **CCSS.ELA-Literacy.W.7.2.A** Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. **COMPUTING SYSTEMS** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **DATA & ANALYSIS** **CSTA 2-DA-09** Refine computational models based on the data they have generated.	• Communicate and express ideas clearly. • Create written or media artifacts to document learning. •	Ask your students to create a marketing campaign promoting the key features of their models. Tell them to include their model's technical characteristics and use scientific facts related to the concepts of speed and energy to highlight their benefits. **SAY/ASK** *Let's design a way to promote the features of your model.*

		The Obstacle Course		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
21 🕒🕒🕒	**Lesson**	**Physical Science: Energy** **NGSS MS-PS3-2** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. **Design Engineering** **NGSS MS-ETS1-3** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **NGSS MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **Computing Systems** **CSTA 2-CS-02** Design projects that combine hardware and software components to collect and exchange data. **CSTA 2-CS-03** Systematically identify and fix problems with computing devices and their components. **Data & Analysis** **CSTA 2-DA-09** Refine computational models based on the data they have generated.	• Create a model of an obstacle course that illustrates the use of potential and kinetic energy	Have students create their own model to illustrate potential and kinetic energy transfer. **Say** *It's time to create your own model to demonstration potential and kinetic energy transfer. Create an obstacle course game that can illustrate energy transfer.* **More Details** *The Obstacle Course* lesson or access in the LEGO® Education SPIKE™ App
22 🕒	**Prompts** **More with Math and ELA**		• Gather and record real world data. • Create and compare graphs.	Have your students use their Hubs to record data outside of the classroom. For example, they could record acceleration values in an elevator, on a playground, or at an amusement park. Ask them to compare and describe the graphs from each location. **Say/Ask** *Let's try to gather some data outside the classroom using our hub.*
23 🕒			• Communicate and express ideas clearly. • Create written or media artifacts to document learning. • Provide feedback to peers.	Have students pair up the groups during the Elaborate phase of the lesson. Have one group present their model while the other group takes notes, asks questions, and interviews them. Ask them to switch roles. Once both groups have shared, have each group create a blog post or video describing what they've seen. **Say/Ask** *Let's practice providing information and answering questions through an interview.*

		Protect Our Produce		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
24 🕒🕒	**Lesson**	**Physical Science: Forces & Motion** **NGSS MS-PS2-1** Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. **Design Engineering** **NGSS MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **Computational Thinking** **CSTA 2-AP-17 6-8** Systematically test and refine programs using a range of test cases.	• Apply Newton's third law to design a solution that harvests produce from a tree, without causing damage from collision. • Systematically test and iterate on their design.	Apply Newton's third law to design a solution that harvests produce from a tree, without causing damage from collision. **Say/Ask** *How can we harvest fruit without causing damage to the trees? Create a tool that will minimize the damage when harvesting a fruit.* **More Details** *Protect Our Produce* lesson or access in the LEGO® Education SPIKE™ App
25 🕒	**Prompt** **More with Math and ELA**		• Communicate and express ideas clearly. • Create written or media artifacts to document learning.	Have your students create written artifacts or give oral presentations based on their creations. Have them present these artifacts to another class, family members, or members of the community for feedback. Have them display their written artifacts publicly (in or out of school) to encourage broader discussion around the central idea. **Say/Ask** *How can we share our creations? Design a written artifact that can help you share your idea with others.*

		Smart House: Go Green		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
26 🕒🕒	**Lesson**	***NGSS MS-ESS3-3*** *Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* **Design Engineering** **NGSS MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	• Design, build, and program a smart home feature to minimize human impact on the environment. • Systematically test, and iterate on their design. • Use conditionals and compound conditionals to program the smart home feature.	Have students design, build, and program a smart home feature to minimize human impact on the environment. **Say/Ask** *How can we minimize human impact on the environment through automation? Automate an aspect of your home to make it more environmentally friendly.*

		Computational Thinking **CSTA 2-AP-12 6-8** Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.	Make an evidence-based argument that supports their design's performance against relevant criteria and constraints.	**More Details** Smart House: Go Green lesson or access in the LEGO® Education SPIKE™ App
27 🕒	**Prompt** **More with Math and ELA**		• Communicate and express ideas clearly. • Create written or media artifacts to document learning.	Have your students create written artifacts or give oral presentations based on their creations. Have them present these artifacts to another class, family members, or members of the community for feedback. Have them display their written artifacts publicly (in or out of school) to encourage broader discussion around the central idea. **Say/Ask** *How can we share our creations? Design a written artifact that can help you share your idea with others.*

	Astronaut Tools			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
28 🕒 🕒	**Lesson**	**Design Engineering** **NGSS MS-ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **NGSS MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	• Collaborate to solve various challenges. • Use engineering design skills to design and build a device that performs a specific task.	Have students collaborate to build a device that can be used by astronauts to perform a task during a spacewalk. Encourage students to think like an engineer to create a device that is user-friendly for astronaut that are wearing glove or who might have limited visibility through their helmets. **Say/Ask** *What are some different features tools need to have in space versus on Earth?* **More Details** *Share the Astronaut Tools placemat* lesson with students for this challenge.

		Autopen		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
29 🕒🕒	**Lesson**	**Design Engineering** **NGSS MS-ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **NGSS MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **Geometry** **CCSS.MATH.CONTENT.8.G.A.1** Verify experimentally the properties of rotations, reflections, and translations.	• Collaborate to solve various challenges. • Use engineering design skills to design and build a device that performs a specific task.	Have students collaborate to design and build a device that can write. Challenge students to have their device write their name, the letters of the alphabet, or a word of their choice. Have your students think like an engineer and consider how will you build a part that tightly holds your pencil and can be picked up and down? **Say/Ask** *How will you build a part that tightly holds your pencil and can be picked up and down?* **More Details** *Share the Autopen placemat* lesson with students for this challenge.
30 🕒	**Prompt** **More with Math and ELA**		• Program their autopen to draw geometric figures. • Use their device to demonstrate rotations, reflections, and translations.	Challenge students to develop a program to draw a line or shape on graph paper or a set of axes. Then, instruct students to demonstrate how their program can be used to illustrate a rotation, reflection, and/or translation. Students may iterate on their program to have the autopen draw the desired result. **Say/Ask** *How can you program your autopen to draw a shape? How can you modify your program to rotate that shape?*

		Addicting Games		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
31 🕒🕒	**Lesson**	**Design Engineering** **NGSS MS-ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **NGSS MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **Writing** **CCSS.ELA-LITERACY.W.8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.	• Collaborate to solve various challenges. • Use engineering design skills to design and build a device that performs a specific task.	Have students collaborate to design a game that is addicting to play. Encourage students to consider what makes a game fun and addicting (e.g. colors, difficulty, speed, scoring, etc.). Encourage students to iterate on their program to make the game increasingly difficult the longer a user plays. **More Details** *Share the Addicting Games placemat* lesson with students for this challenge.
32 🕒	**Prompt** **More with Math and ELA**		• Write explanatory texts to demonstrate the instructions/rules of their game to a new user.	Have students write a draft of instructions for the game that they created. Then, have students share their instructions with a peer and solicit feedback. Encourage students to revise their initial draft to incorporate their peer's feedback to convey the concept of their game clearly and concisely.

		Training Camp 1: Driving Around		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
33 🕒🕒	**Lesson**	**Design Engineering** **NGSS MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	• Learn how to execute controlled movements using a Driving Base	Have your students build a Practice Driving Base and make precise and controlled movements. Examples of controlled movements include a straight move, point turn, curved move, turn with sensor, drive in a shape. **More Details** *Training Camp 1: Driving Around* lesson or access in the LEGO® Education SPIKE™ App

34 L	**PROMPT** **More with Math and ELA**	**COMPUTING SYSTEMS** **CSTA 2-CS-01 6-8** Recommend improvements to the design of computing devices, based on an analysis of how users interact with the devices. **WRITING** **CCSS.ELA-LITERACY.W.8.1** Write arguments to support claims with clear reasons and relevant evidence.	• Explain the most precise way of traveling and why they chose that option.	Have your students look for the most precise way of traveling a distance of 2 meters by exploring these options: ▷ Move in seconds ▷ Move in degrees ▷ Move in rotations ▷ Move with sensor Ask them to create a document explaining in which situation(s) they'd use each option, and why.

		Training Camp 2: Playing with Objects		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
35 L L	**LESSON**	**DESIGN ENGINEERING** **NGSS MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **COMPUTING SYSTEMS** **CSTA 2-AP-12 6-8** Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. **WRITING** **CCSS.ELA-LITERACY.W.8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.	• Use estimation to stop at an object. • Use the Distance Sensor to detect and object and respond.	Have your students se sensors to control motors and interact with objects. **SAY/ASK** *Can you describe situations where you have seen robots move objects from one place to another?* **MORE DETAILS** *Training Camp 2: Playing with Objects* lesson or access in the LEGO® Education SPIKE™ App
36 L	**PROMPT** **More with Math and ELA**		• Write a set of rules for their game and incorporate supportive images.	*Have your students redesign the game and come up with their own set of rules. Ask them to write down the rules and to create supportive images. Have the teams challenge each other.*

		Training Camp 3: Reacting to Lines		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
37 🕒🕒	**Lesson**	**Design Engineering** **NGSS MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **Algorithms & Programming** **CSTA 2-AP-12 6-8** Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.	• Program the Driving Base to stop at a black line. • Program the Driving Base to follow a black line.	*Have your students build the Driving Base with Color Sensor and program the base to react to lines.* **Say/Ask** *How can you use lines and the Color Sensor to help make their Driving Base program more effective?* **More Details** *Training Camp 3: Reacting to Lines* lesson or access in the LEGO® Education SPIKE™ App
38 🕒	**Prompt** **More with Math and ELA**	**Algorithms & Programming** **CCSS.ELA-LITERACY.SL.8.4** Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.	• Present a program and evaluate the performance of the program compared to others.	• *Present a program called differentiated line follower (see coding tips section) and have your students try to decode how the program works.* • *Ask your students to evaluate the performance of this program compared to their previous line-follower programs.*

		Maze Challenge		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
39 🕒🕒	**Lesson**	**Design Engineering** **NGSS MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	• Create a maze for with a clear starting point and finish. • Program the Driving Base to successfully navigate the maze.	Have student apply their learning from the *Competition Ready: Training Camp* lessons to design a maze and challenge their peers to guide their Driving Base through the maze and obstacles. In groups, have students create a maze using tape on the floor or other classroom objects to define the maze walls. Include a clear starting point and goal location. Then, have students program their Driving Base to navigate the maze. Encourage students to iterate upon and

		ALGORITHMS & PROGRAMMING **CSTA 2-AP-12 6-8** Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. **CSTA 2-AP-13** Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. **WRITING** **CCSS.ELA-LITERACY.W.8.3** Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.		improve their program until the Driving Base can successfully navigate from start to finish. **SAY/ASK** *How can you use lines and the Color Sensor to help make their Driving Base program more effective?* **MORE DETAILS** Explore the *Competition Ready* unit or access in the LEGO® Education SPIKE™ App
40 🕒	**PROMPT** **More with Math and ELA**		• Modify their maze to increase difficulty and require additional programming to complete defined criteria. • Iterate upon their programs to adapt to new maze challenges.	Challenge students to increase the difficulty of their maze. Challenges to increase difficulty could include: ▷ Have students collaborate to solve the mazes of their classmates. ▷ Include obstacles in the design of your maze to require more turns and navigation in the program. ▷ Include at least one sensor one your Driving Base and develop a program that uses the sensor to solve the maze. ▷ Establish minimum criteria for maze creation. (e.g., at least three turns, a straight stretch that is less than one wheel rotation, checkpoints within the maze that must be completed in order to finish, etc.)
41 🕒			• Design or revise their maze to represent events or details from a story.	Develop or revise your maze to represent a story or subject you have discussed in class. Include objects, obstacles, and checkpoints related to the plot of the story. **SAY/ASK** *Can you develop a maze (or path) that represents a story we have read in class or a story that you have developed?*