LEGO® Education
STEAM Learning Progression

SPIKE™ Essential Grade 4

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), Modify 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 4

Complete the full STEAM Progression in Activities 1–51

OR

choose from one of the paths.

COMPUTER SCIENCE PROGRESSION	SCIENCE PROGRESSION	SKILLBUILDERS AND EXTENSIONS
Mini Mini-Golf (Activities 6–7)	*Mini Mini-Golf* (Activities 6–7)	Design Engineering (Activities 2–4, 8–9, 12, 14, 17, 19, 22–23, 25–26, 28–29, 44, 46)
Bowling Fun (Activities 13–15)	*How Eyes See* (Activities 8–11)	Meet the Hardware (Activities 3, 5, 34, 38)
High Stick Hockey (Activities 16–18)	*Bowling Fun* (Activities 13–15)	ELA/Literacy (Activities 4, 11–12, 15, 21, 27, 32, 34, 36, 42, 45, 47–48, 51)
A-Maze-Ing (Activities 35–38)	*High Stick Hockey* (Activities 16–18)	Math (Activities 7. ,10. 14, 17–18, 24, 30–31, 33, 36, 40, 44, 47)
Avoid the Edge (Activities 39–40)	*Animal Structures* (Activities 19–23)	
Junior Pinball (Activities 43–45)	*Information Transfer* (Activities 25–26)	
Creative Carnival Games (Activities 50–51)	*Prepare for Natural Hazards* (Activities 28–33)	
	A-Maze-Ing (Activities 35–38)	
	Avoid the Edge (Activities 39–40)	
	Junior Pinball (Activities 43–45)	
	Energy Resources (Activities 46–48)	
	Creative Carnival Games (Activities 50–51)	

#	Activity Name	Topic(s) and Standards	Objectives Students will	Prompt
1 L	PROMPT **Back-to-Back with Bricks** 	**Sequences** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.	• Investigate what makes a sequence by practicing creating step-by-step instructions. • Understand the importance of clear steps and directions.	Use a follow-the-steps activity to introduce students to the coding concept of sequencing. Organize pairs back-to-back and provide each partner with the same 5–6 bricks. Prompt students to take turns building and doing a Q&A together. **Say/Ask** *Build a model. Think about the steps you used to build it. Without showing the model, invite your partner to ask Yes/No questions about how to build something just like it. Remember to answer only with Yes or No. Then change roles and ask questions to build your partner's model. What happens? Was it easier to ask questions or answer them? Would this task be easier if you could give directions?* **More Details** *Basic Coding Concepts in LEGO® Education SPIKE™ Essential Lessons*
2 L	PROMPT **Build a Bridge with Bricks** 	**Design Engineering** **NGSS 3-5 ETS 1-3** 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 a bridge to specific requirements. • Test the bridge to determine how much weight it holds.	Introduce basic design engineering tests with a quick bridge builder. Provide each student with 12 bricks. Prompt them to build a bridge that spans a chosen distance (e.g., road bridge over water, foot bridge over a road, train bridge). Then prompt them to use a common element type, such as tires or wheels, to test the bridge's strength. **Say/Ask** *Use the 12 bricks to make a bridge. Make sure it's high enough to fit your hands under without touching any part of the bridge. Then test the bridge by adding weight. Use an element you have a lot of, like wheels or tires. How many does the bridge hold? Keep adding to find out.*

3	**PROMPT** **Meet the Motor** 	**SEQUENCES** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **DESIGN ENGINEERING** **NGSS 3-5 ETS 1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	• Build a model to meet specific criteria. • Explore programming a motor. • Use appropriate terminology when using hardware.	Prompt students to add a motor to their bridge and program it to raise and lower the bridge like a drawbridge. As needed, refer students to The Motor tutorial in their LEGO® Education SPIKE™ App. **SAY** *Add a motor to your bridge. Program it to raise and lower the bridge. If you need help, complete The Motor tutorial in your SPIKE App.* **MORE DETAILS** *The Motor* tutorial in the START section of the SPIKE App, available on the web or downloaded.
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
4	**PROMPT** **More with ELA**	**READING LITERATURE** **CCSS.ELA-Literacy.RL.4.3** Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text (e.g., a character's thoughts, words, or actions). **NARRATIVE WRITING** **CCSS.ELA-Literacy.W.4.3.B** Use dialogue and description to develop experiences and events or show the responses of characters to situations. **DESIGN ENGINEERING** **NGSS 3-5 ETS 1-2** 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.	• Describe a story character using specific details to identify a problem he or she has. • Design and build a solution to the character's problem. • Use a solution to describe a character's response to the story situation.	Have student pairs identify a character from a story they're currently reading. Prompt them to design and build a way for the character to solve a story problem or complete a task. Then invite them to explain why their solution fits with their character's likely response to the problem. **SAY/ASK** *Leo and Maria love to tell stories. When they tell a story they like to think about how to help the characters. Think about the story we read. Design and build something to help one of the characters solve a problem or complete a task. Given what you know about the character, why is this a good solution for him or her?*

5	**PROMPT** **Meet the Light Matrix** 	**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. • Use appropriate terminology when using hardware.	Introduce/Review the Light Matrix as students program it to make a pattern for a memory game. Refer them as needed to the Light Matrix tutorial in their LEGO® Education SPIKE™ App. **SAY** *Take turns playing this memory game. Connect the Light Matrix to your hub. Program it to make a pattern of colored lights. Then ask your partner to repeat the pattern, first by showing it with colored bricks and then by programming their own Light Matrix to show it. As you play, make the pattern longer each time. If you need help, use The Light Matrix tutorial in your SPIKE App.* **MORE DETAILS** *The Light Matrix* tutorial in the START section of the SPIKE App, available on the web or downloaded.

	**Mini Mini-Golf**			
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
6	**LESSON**	**ENERGY: SPEED AND COLLISIONS** **NGSS 4-PS3-1** Use evidence to construct an explanation relating the speed of an object to the energy of that object. **DATA AND ANALYSIS** **CSTA 3-5 1B-DA-7** Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.	• Explore the basic principles of energy and their connection to an object's speed. • Identify and describe the relationship between speed and energy. • Engage effectively in a range of collaborative discussions.	Have students build and program a mini-golf model that can shoot a hole-in-one. **SAY/ASK** *Sofie wants to test her mini-golf skills. Build the mini-golf model and program it to help Sofie get a hole-in-one. What does it show you about the relationship between speed and energy?* **MORE DETAILS** *Mini Mini-Golf lesson* or access in the LEGO® Education SPIKE™ App.
7	**PROMPT** **More with Math**	**GEOMETRY** **CCSS.MATH.Content.4.G.A.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.	• Identify and draw line-symmetric figures.	Have your students investigate line-symmetric figures in the *Mini Mini-Golf* lesson. Ask them to record the different angles of the mini-golf club, and then draw and label the figures and all relevant parts (e.g., parallel lines, perpendicular lines, angles). **SAY/ASK** *What angles do you see in the mini-golf club? Draw and label all the parts, including parallel or perpendicular lines and angles.*

	How Eyes See			
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
8 🕒🕒	**Lesson Part A**	**Light Refraction and Vision** **NGSS 4-PS4-2** Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. **Design Engineering** **NGSS 3-5 ETS 1-1** 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 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.	• Build an accurate model of a movable light source. • Use the model to describe how light reflects from objects to enter the eyes, allowing the objects to be seen. • Use the model to explain what happens if the light source is blocked or diminished.	After students build Daniel's car, have them program the light on it to shine on objects. Prompt them to test the light with different objects to discover how it helps Daniel see them. **Say/Ask** *Daniel finds something while exploring a dark cave. Can you help him see it better? Build his car and program it to light things inside the cave. How does the path of light let an object be seen? Test to find out.* **More Details** *How Eyes See* lesson or access in the LEGO® Education SPIKE™ App
9 🕒🕒	**Lesson Part B**			Have students modify the program to show how changing the car's location affects the path of light and Daniel's ability to see objects. Then have them test again. **Say/Ask** *Daniel wants to drive around in the cave. Program the motor so that the car can move to new parts of the cave. How does the car's location change the path of light? How does it change Daniel's ability to see objects? Could you make some objects easier to see if you moved the car? Why?* **More Details** *How Eyes See* lesson or access in the LEGO® Education SPIKE™ App; Students may also find inspiration in the *Big Bus* lesson.
10 🕒	**Prompt More with Math**	**Measurement and Data** **CCSS.MATH.Content.4.MD.B.4** Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection. **Data and Analysis**	• Measure distances in ¼ and ½ inch/cm intervals. • Plot data about the relationship between distance and ease of sight on a lighted object. • Create a line graph in various formats.	Ask students to plot a data table while moving the car. Prompt them to measure at intervals of ½ or ¼ an inch or cm away from the object, and then track how well they can see the object. Then have them create a line graph with the data to show the trend of changing from seeing well to not seeing the object. If you wish, students may create the graph in the SPIKE App with Log and Visualize Data Over Time Blocks. **Say** *Explore how much distance from the object affects the success of Daniel's car light. Measure at ½ or ¼ inch (or cm) intervals from the object. Place the car at each measured spot and record how well you can see the object. Show your*

		CSTA 3-5 1B-DA-06 Organize and present collected data visually to highlight relationships and support a claim. **CSTA 3-5 1B-DA-07** Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.		*data on a line graph. You can create it on paper or with graphing tools in the* SPIKE *App.* **More Details** *Log and Visualize Data Over Time Blocks* in the Help section of the SPIKE App, available on the web or downloaded.
11	**Prompt** **More with ELA**	**Informative Writing** **CCSS.ELA-Literacy.W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. **CCSS.ELA-Literacy.W.4.2.B** Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.	• Write a news article about an animal that sees well in dim light. • Develop the topic with facts, details, and examples about the animal.	Extend students' exploration of how light affects the ability to see objects. Provide learning materials about animals that, unlike humans, can see very well in the dark. Ask students to choose one of these animals and write a brief newspaper article that describes how it sees in the dark and how far. **Say** *Learn about animals that see better in the dark than humans. Write a news article about one of them. Explain how the animal sees well in dim light and tell how far it can see.*

#	Activity Name	Topic(s) & Standards	Objectives Students will	Prompt
12	**Prompt** **More with ELA**	**Speaking and Listening** **CCSS.ELA-Literacy.SL.4.4** Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace. **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. • Retell a familiar story with a beginning, middle, and end. • Design and build models to represent the beginning, middle, and end of the story.	Organize pairs to collaboratively retell a familiar story. 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. Then build three models, one that shows the beginning, one that shows the middle, and one that shows the end.*

Bowling Fun

#	Activity Name	Topic(s) & Standards	Objectives Students will	Prompt

13 🕒🕒	**LESSON**	**ENERGY: SPEED AND COLLISIONS** **NGSS 4-PS3-3** Ask questions and predict outcomes about the changes in energy that occur when objects collide. **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.	• Predict outcomes of the changes in energy that occur when objects collide. • Observe and describe the relationship between energy and force. • Retrieve and modify an existing program to improve the bowling game.	Have students explore the energy involved when objects collide. Prompt them to build a bowling game for Daniel and program it to get strikes. (As needed, explain that a strike is when the bowler knows down *all* the pins with one ball.) **SAY** *Daniel is frustrated. He wants to bowl like his friends. Build the bowling game and program it to help Daniel get a strike. Then see if you can improve the program.* **MORE DETAILS** *Bowling Fun* lesson or access in the LEGO® Education SPIKE™ App
14 🕒	**PROMPT** **More with Math**	**MEASUREMENT AND DATA** **CCSS.MATH.Content.4.MD.B.4** Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection. **DESIGN ENGINEERING** **NGSS 3-5 ETS 1-3** 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. **DATA AND ANALYSIS** **CSTA 3-5 1B-DA-06** Organize and present collected data visually to highlight relationships and support a claim. **CSTA 3-5 1B-DA-07** Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.	• Carry out tests to determine how variables (e.g., type of pin, distance between ball and pins) affect the energy in a collision. • Plot fraction data to show the relationship between pins knocked down and total pins. • Create a line graph in various formats.	Have students build up to eight additional bowling for Daniels' game. Then have them run several bowling trials, recording their data after each roll. Prompt them to express the data (how many pins were knocked down) as a fraction of the total pins. If time allows, have students change the distance from ball to pins and run additional trials to see how it changes the data. If you wish, students may create the graph in the SPIKE App with Log and Visualize Data Over Time Blocks. **SAY/ASK** *Build up to eight additional bowling pins. Run several bowling tests to see how many the game can knock over. Express the results as fractions that show the relationship between pins knocked down and total pins.* ***Then try this>*** *Put the pins at different distances from the ball and test again. What happens this time? How much does distance from the pins affect the success of the game? Show your data on a line graph. You can create it on paper or with graphing tools in the* SPIKE™ *App.* **MORE DETAILS** *Log and Visualize Data Over Time Blocks* in the HELP section of the LEGO® Education SPIKE™ App, available on the web or downloaded.
15 🕒	**PROMPT** **More with ELA**	**RESEARCH FOR WRITING** **CCSS.ELA-Literacy.W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic.	• Use sources and experiences to research accessibility in public spaces. • Write an informational poster or flyer showing	Have students research (with sources, interviews, or personal experiences) accessibility in public spaces like schools, buses, or bowling alleys. Prompt them to write a flyer or poster explaining how spaces, and the elements in them like stairs or restrooms, can be modified so everyone can use them. Encourage them to illustrate at least one idea.

		CCSS.ELA-Literacy.W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.	how spaces and elements in them can be modified to be accessible to everyone.	**SAY/ASK** *What are some ways that places like bowling alleys and other public places should change so that everyone can use them? Find out, using sources, personal experience, or interviews with people you know. Then write a flyer or poster pamphlet explaining what you learned. Include drawings or pictures of one change.*

	**High Stick Hockey**			
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
16	**LESSON**	**ENERGY TRANSFER AND TRANSFORMATION** **NGSS 4 PS3-2** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. **SEQUENCES** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.	• Observe and describe how energy can be transferred. • Predict how energy moves from place to place. • Engage effectively in a range of collaborative discussions.	After students build the hockey game simulator, have them use it to investigate energy transfer. Prompt them to create a program to test how many goals they can score in three tries. Then encourage them to improve the program so that the game is more fun or to change the model so that it's harder to score. **SAY/ASK** *Maria is excited to try the hockey game simulator. Build it and program to see how many goals you can score in three tries. How did the energy being transferred from the hockey stick to the ball impact the ball's motion? How was the energy of the ball impacted when it collided with the wall?* ***Then try this>*** *Change the program so that the game is more fun OR change the model so that it's harder to score.* **MORE DETAILS** *High Stick Hockey* lesson or access in the LEGO® Education SPIKE™ App
17	**PROMPTS** **More with Math**	**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. **MEASUREMENT AND DATA** **CCSS.Math.Content.4.MD.C.5** Recognize angles as geometric shapes that are formed wherever two rays share a common	• Modify a model and program to generate new ways to solve a stated problem. • Test and refine the different solutions, comparing results. • Measure and identify the angles that are most effective for moving the	Have students add a second motor to their hockey game, and then revise the program so the hockey stick swings automatically. Prompt them try different angles for the hockey stick to see which is the most effective in moving the ball. **SAY/ASK** *Add a second motor to the hockey game. Find a way to make the hockey stick swing automatically! (You may have to revise the program.) Then experiment with*

		endpoint, and understand concepts of angle measurement. **COMPUTATIONAL THINKING** **CSTA 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	hockey ball.	*swinging the stick from different angles. Measure each angle you test. Which moves the ball the most effectively?*
18		**NUMBERS AND OPERATIONS: FRACTIONS** **CCSS.Math.Content.4.NF.C.6** Use decimal notation for fractions with denominators 10 or 100.	• Record test results using fractions and decimal notations.	Have students record ten scoring attempts and compare the results. Tell them to write the number of goals as one fraction, and the number of saves as another fraction. Then have them express the results in decimal form. **SAY/ASK** *Test your improved hockey game again. Record the results of 10 tries. How many goals did you make? How many were blocked? Record the answer to each question as a fraction of 10. Then express the numbers as decimal.*

Animal Structures

#	Activity Name	TOPIC(S) & Standards	Objectives Students will	Prompt
19	**LESSON** **Part A**	**PLANT AND ANIMAL STRUCTURES** **NGSS 4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **DESIGN ENGINEERING** **NGSS 3-5 ETS 1-1** 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-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.	• Build a model to show how an elephant's trunk supports eating, drinking, bathing, or communicating. • Construct an argument based on evidence from the model that an elephant's external and internal structures help it to survive. • Test and modify the program to improve its performance.	After students build the model elephant, have them program it to show how the elephant uses its trunk to reach food or make elephant sounds. Guide them to test, debug, and improve their program until it runs as intended. **SAY/ASK** *Maria sees an elephant eating. She wonders about ways it can use its trunk. Build and program a model to help Maria learn. Give the elephant model a movable trunk. Then program it to show how it uses that trunk to reach food in high places or to make elephant sounds to communicate. Test and debug your program so it runs the way you mean it to.* **MORE DETAILS** *Animal Structures* lesson or access in the LEGO® Education SPIKE™ App
20	**LESSON** **Part B**			Guide students to learn more about elephant structures, this time exploring internal structures. Share background about functions that internal structures are used for, like breathing

				(lungs), eating (stomach), pumping blood (heart), and thinking and controlling (brain). Give examples of ways to show these with bricks, like 1) using a red brick for a heart and programming the model with light or sound to "beat," 2) using two white or clear bricks for lungs and programming the model to play a recording of their own breathing, and 3) using a sensor as a brain and programming it to make a part of the model do something, e.g., the ears move. **SAY** *Next, Maria wants to learn how elephants use parts of their bodies that are* inside, *like their lungs or stomach. Add new elements to the model to represent one of these structures and program to show how elephants use it to survive, such as using lungs to breathe or a stomach to eat.* **MORE DETAILS** *Animal Structures* lesson or access in the SPIKE App
21 **PROMPT** **More with ELA**		**READING INFORMATIONAL TEXTS** **CCSS.ELA-Literacy.RI.4.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. **PLANT AND ANIMAL STRUCTURES** **NGSS 4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **INFORMATIVE WRITING** **CCSS.ELA-Literacy.W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	• Explain how structures of a plant or animal help it to survive and grow. • Use information from research to write an informative brochure.	Provide learning materials about animals' and plants' internal and external structures. Have students pick an animal or a plant and create a nature museum brochure to describe how these structures allow the plant or animal to thrive in its living environment. **SAY** *Learn about ways that other living things use their structures to survive and grow. Choose one animal or plant. Use what you read to create a nature museum brochure. Tell readers how internal or external structures help this plan or animal to thrive where it lives.*
22 **PROMPTS** **More with Science**		**PLANT AND ANIMAL STRUCTURES** **NGSS 4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **DESIGN ENGINEERING**	• Use research to learn about animal communication. • Design and build a model to show what they learned. • Compare different solutions from the class to	Share that some animals communicate using their structures. For example, a firefly can communicate with its lights (also called bioluminescence). Have students research animals that can communicate using structures, like with movement, light and sounds. Then prompt them to design, build, and program a model to represent that communication.

		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.	see which works best for communication.	**SAY/ASK** *Remember how Maria's elephant used its trunk to make sounds and communicate? Other animals do that too, using the structures they have. Learn about one of those animals, like fireflies. Design, build, and program a model that shows the communication. Compare your models with classmates. Which ones might communicate best?*
23			• Invent a new animal that has the structures it needs to live and interact with animals around it. • Build a model that shows how the animal uses its structures.	Have students invent an imaginary animal. Lead discussion about different animal structures, like scales, beaks, feathers, or tails. Then encourage students to combine these structures or create new ones, so that their imaginary animal can live and interact with animals around it. Ask students to design, build, and program their animal to show their ideas. **SAY/ASK** *You've learned a lot about animal structures. Now invent your own animal. Give it the structures it needs to live and interact with other animals. You can use real structures from other animals, like scales, beaks, or features, or make up new ones. Don't forget to give your new animal a name!*

#	Activity Name	TOPIC(S) & Standards	Objectives Students will	Prompt
24	PROMPT **More with Math**	**GENERATE AND ANALYZE PATTERNS** **CCSS.MATH.Content.4.OA.5** Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way. **SCIENCE SKILL PRACTICE: INFORMATION TRANSFER – PATTERNS** Develop patterns to prepare for NGSS 4-PS4-3.	• Practice communication skills through collaborative retellings. • Retell a familiar story with a beginning, middle, and end. • Design and build models to represent the beginning, middle, and end of the story.	To prepare for the *Information Transfer* lesson, have students explore patterns as forms of communication. Explain that people use patterns to communicate ideas many ways, like secret codes, music, and even fabric that that identifies your family (Scottish tartans). Organize pairs and provide each partner with the same set of bricks. They should create patterns with their bricks, without showing each other. Then have them take turns describing the pattern as the listener tries to build it. After each round, reduce how much the speaker can say to describe each piece in the pattern. **SAY** *Without showing anything to your partner, use bricks to make a pattern. Then take turns describing patterns and trying to build what your partner describes. After each round, I'll tell you how many words you can use for the next round. Get ready. It's going to get harder each time!*

		**Information Transfer**		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
25 **Lesson** **Part A**		**Information Transfer: Patterns** **NGSS 4-PS4-3** Generate and compare multiple solutions that use patterns to transfer information. **Design Engineering** **NGSS 3-5 ETS 1-1** 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-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.	• Design at least two different methods for transferring information using patterns. • Identify criteria and constraints for testing the design solutions. • Evaluate each of their design solutions for speed, accuracy, and ease of use.	Have students apply their learning from the More with Math Skill Practice activity as they develop codes for the SPIKE team to use in communicating. Prompt them to build and program models that can send and receive coded messages. **Say** *Maria, Leo, Daniel, and Sofie use a special code to share ideas. Make your own code to communicate with your friends. Create and write down at least two different codes for sending words with the letters A–E (for example, A = wolf sound; B = bird sound; C = cat sound; and so on). Then build and program a model that can send coded messages with at least two systems. Try it with a partner or another group.* **More Details** *Information Transfer* lesson or access in the LEGO® Education SPIKE™ App
26 **Lesson** **Part B**				Use a Jigsaw or other familiar sharing routine for students to compare coding systems and ideas, using common criteria like speed, accuracy, and ease of use. After students apply any improvement ideas from sharing, lead them in collecting the comparison data in a class vote for the best system. **Say/Ask** *Share coding systems, models, and programs with your classmates. How fast are they to use? How accurate are the message? How easy are they to use? Compare all the solutions. Then take some ideas back to improve your model and program. Last, let's vote for the best solutions.* **More Details** *Information Transfer* lesson or access in the LEGO® Education SPIKE™ App
27 **Prompt** **More with ELA**		**Research for Writing** **CCSS.ELA-Literacy.W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic. **Informative Writing**	• Research to learn about historical use of codes to transfer information. • Write and illustrate an informative poster that explains how the method works.	Provide learning materials about codes and patterns used to transfer information, including during important moments in history (e.g., Morse code; Civil War flag codes; World War I Choctaw codes; World War II Enigma device; or search "best codes in history"). Have students explore one method and then present learning through a poster that explains and illustrates how it works.

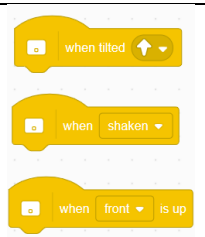
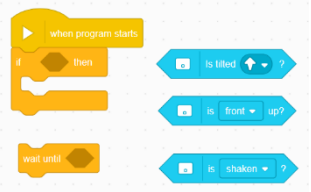
		CCSS.ELA-Literacy.W.4.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.		**SAY** *People have used codes to transfer information many times in history. Learn about one of these. Then create a poster that explains and illustrates how the method works.*

	**Prepare for Natural Hazards**			
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
28 **LESSON** **Part A**		**NATURAL DISASTERS, PREPAREDNESS** **NGSS 4-ESS3-3** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. **DESIGN ENGINEERING** **NGSS 3-5 ETS 1-1** 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-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.	• Design a model for buildings that will reduce the impacts of earthquakes on humans. • Use their model to evaluate the effectiveness of their design solution. • Use several models to compare the effectiveness of two or more design solutions.	Have students explore steps people can take to keep buildings safe during earthquakes. After building a shake machine and at least one building, prompt students to program the machine to shake the building at different motor speeds or amounts of shaking force. Then have them test their building at different speeds to see how long different designs stand at different speeds. Guide students to connect the materials and shapes in buildings to their ability to withstand shaking force. **SAY/ASK** *Leo knows some places have earthquakes. To keep people safe, help him design buildings that won't be destroyed by earthquakes. Build and program the earthquake machine to test the buildings you create. Start testing a low motor speed, and then increase (25%, 50%, 75%, 100%). How long does each building stand at different speeds? Which building designs fall right away? Why?* **MORE DETAILS** *Prepare for Natural Hazards* lesson or access in the LEGO® Education SPIKE™ App
29 **LESSON** **Part B**				Prompt students to add protections for the people inside their building(s). Have them revise their model and program to include an alarm that warns an earthquake is coming. **SAY/ASK** *What else can we do to reduce the impacts of earthquakes? Improve and program your building model so that an alarm warns people an earthquake is coming.* **MORE DETAILS** *Prepare for Natural Hazards* lesson or access in the SPIKE App

30	**PROMPTS** **More with Math**	**GEOMETRY** **CCSS.MATH.Content.4.G.A.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.	• Revise buildings for symmetry. • Retest to determine whether symmetry makes buildings more earthquake resistant.	Prompt students to redesign their test buildings to be symmetrical, and then compare with their original buildings. They should retest to determine how symmetry affects the earthquake resistance of the design. As needed, define or review *symmetry* with students. **SAY/ASK** *What changes might make your building more stable in an earthquake? Redesign to make your building(s) symmetrical. Retest to see if the building(s) respond differently to shaking force. Then test again and compare with your original building(s) and those of your classmates.*
31		**MEASUREMENT AND DATA** **CCSS.MATH.Content.4.MD.A.1** Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. **DATA ANALYSIS** **CSTA 3–5 1B-DA-07** Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.	• Create a data table to record findings in seconds and minutes. • Use data to propose cause-and-effect relationships between building design and earthquake resilience.	Have students organize their building test results in a two-column data table reflecting how long buildings remained standing. Their table should record time in seconds and as minutes expressed in terms of seconds. Prompt them to record data for at least 3 designs of different heights, using either or both symmetrical and non-symmetrical buildings. **SAY** *Record your test data. Make a two-column table for seconds and minutes. For each building, record the time the building stayed standing in seconds and in minutes as a number of seconds. Use your data to share ideas about the impact of building design on earthquake stability.*
32	**PROMPT** **More with ELA**	**READING INFORMATIONAL TEXT** **CCSS.ELA-Literacy.RI.4.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.	• Research to learn about ancient building methods to resist earthquake damage. • Explain key concepts, using specific information from texts.	Provide learning resources about materials used by ancient Japanese, Chinese, or Roman builders to resist earthquake damage. (Search for *ancient Chinese/Japanese/Roman earthquake proof buildings*) Have students examine one example and share key concepts and details. **SAY** *People in ancient cultures from Japan, China, and Rome also worked to design earthquake resistant buildings. Learn about one example. Share key ideas with the class, including important details about what ancient builders did and why it worked or didn't.*
33	**PROMPT** **More with Math**	**MEASUREMENT AND DATA** **CCSS.MATH.Content.4.MD.A.1** Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express	• Design, build, and program a driving robot to navigate a path. • Measure the distances on a scaled path in cm and convert to meters or	Share that robots can help people during natural disasters, for example by reach into narrow spaces. Ask students to design, build and program a driving robot that can navigate through a small space. Create a path as a scaled-down representation of a real path. (Use a familiar local path or a national one like the Appalachian Trail or National Mall in

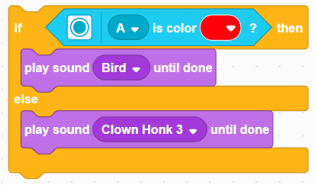
		measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. For example: Know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36),	kilometers that represent the real-life distances. • Program the robot to navigate the path correctly.	Washington, D.C.) Have students measure the distance of each part of the path in cm then convert to meters or kilometers to represent the real-life distance. Then prompt them to program the models to complete the path. **ASK/SAY** *Sometimes when natural disasters happen, we need to get into narrow places to help. People cannot always get into those places, but robots can. Design, build, and program a driving robot that can navigate on a path. Then measure the distance on a small path representing [insert name of path]. Record the measurement in inches/cm and convert to feet/meters that represent the real path. Program your model to travel the path.*

#	Activity Name	TOPIC(S) & Standards	Objectives Students will	Prompt
34	PROMPT **More with ELA**	**READING LITERATURE** **CCSS.ELA-Literacy.RL.4.3** Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text (e.g., a character's thoughts, words, or actions). **READING SKILL PRACTICE: STORY SETTINGS**	• Describe the setting in a story with specific details. • Modify the setting in a story to determine how the change affects the story.	Share that students have built models in response to many stories about Maria, Daniel, Sofie, and Leo as the friends travel to different settings. Prompt students now to imagine any of those stories in a new setting. Ask them to describe a new setting in detail and then share what would change about the story. **SAY/ASK** *You've helped Maria, Daniel, Sofie, and Leo solve problems in stories within many different settings. But what if one of those stories were moved to a new setting? What would that new setting be like? How would it change the story? Choose one setting that the team has visited. Change it for another place and retell the surrounding story.*
34	PROMPT **Meet the Gyro Sensor** 	**SEQUENCES** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **SOFTWARE 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 for the Built-in Gyro sensor. • Create word block sequences using sensors.	Have students explore the different ways to use the Built-in Gyro Sensor to start a program (Event blocks) or change the action in a program (Sensor blocks). First prompt students to connect a motor and the Light Matrix to their hub. They should 1) create several different programs using the Gyro Sensor to start a program, 2) investigate the blocks below, and 3) add to the program to make the motor move and Light Matrix light up.

				 Next, ask students to create new programs using the Gyro Sensor in the program, such as with combinations like these.  Discuss different ways the Gyro Sensor can be used in a program. As needed, use gesture to clarify tilt and/or have students complete the Built-In Gyro Sensor tutorial. **SAY** *Practice using the Gyro Sensor that is built into the hub. Connect the Light Matrix to the hub. Write a program to start a program and to make the motor move or Light Matrix light up. Try combinations of different blocks.* **MORE DETAILS** *The Gyro Sensor* tutorial in the START section of the LEGO® Education SPIKE™ App, available on the web or downloaded.

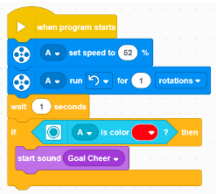
	**A-Maze-Ing**			
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
35 **LESSON**		**DATA ANALYSIS** **CSTA 3–5 1B-DA-07** Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea. **ENERGY TRANSFER AND TRANSFORMATION** **NGSS 4 PS3-2** Make observations to provide evidence that energy can be transferred from	• Observe and explain how interactions between two objects can impact the energy of an object. • Compare and iterate to improve the design of the solution. • Engage effectively in a	After students build the maze, have them program it to count the number of tilts it takes to complete it. Prompt them to try to beat Leo's record. Discuss what happens to the ball's energy as it hits the different obstacles in the maze, and how to use this understanding in their maze designs.

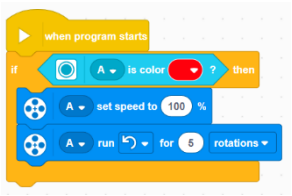
		place to place by sound, light, heat, and electric currents.	range of collaborative discussions.	**SAY** *Leo won the maze competition. He completed the maze in only six tilts. Build and program a maze that counts the number of tilts it takes to complete. Try to beat Leo's tilts.* **MORE DETAILS** *A-Maze-Ing* lesson or access in the LEGO® Education SPIKE™ App
36	**PROMPT** **More with Math, ELA, and Computer Science**	**DATA AND ANALYSIS** **CSTA 3–5 1B-DA-06** Organize and present collected data visually to highlight relationships and support a claim. **NUMBERS AND OPERATIONS: DECIMALS** **CCSS.MATH.Content.4.NF.C.7** Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model. **INFORMATIVE WRITING** **CCSS.ELA-LITERACY.W.4.2.C** Link ideas within categories of information using words and phrases (e.g., another, for example, also, because).	• Use Bar Graph blocks to organize maze results data visually. • Use information from the Bar Graph Block to compare maze results with those of another team. • Write a paragraph comparing results, using language such as *more than*, *less than*, and *equal* to statements. • Use language such as *similarly*, *also*, *both* to show similarities and *instead*, *in contrast*, *but/yet* to show differences.	Using the information gathered from the Bar Graph Block, ask students to write a paragraph comparing their results to another group's results. Review and tell students to use *more than*, *less than*, and *equal* to statements, as well as comparative conjunctions such as *similarly* and *in contrast*. **SAY** *Use the Bar Graph Blocks to compare and contrast your maze results with those of your classmates. Then write a paragraph explaining the results. Use comparison and contrast language, such as* more than, less than, *and* equal to *statements, as well as comparative conjunctions such as* similarly *and* in contrast. **MORE DETAILS** *Bar Graph Blocks* in the Help section of the SPIKE App, available on the web or downloaded.
37	**PROMPT** **More with Computer Science**	**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.	• Modify an existing solution to make it meet different needs.	Allow students to try to complete another group's maze design, completing the mazes as quickly as they can. Have them add the Timer Block with a sound to their program to alert the other team when time is up. **SAY** *Try completing another group's maze design, working to finish as quickly as possible. Before you start, add the When Timer Block to your program, so that it plays a sound when time is up.* **MORE DETAILS** *When Timer Block (Event Blocks)* in the Help section of the LEGO® Education SPIKE™ App, available on the web or downloaded.
38	**PROMPT** **Meet the Color Sensor**	**SEQUENCES** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.	• Follow instructions to create a program. • Use appropriate terminology when using	Guide students to play a guessing game. Have them connect the Color Sensor to the hub. Partner A programs the Color Sensor to play a sound if the chosen color (red in the example) is sensed and another sound if it doesn't sense that

		**COMPUTING SYSTEMS** **CSTA 3-5 1B-CS-02** Describe how internal and external parts of computing devices function to form a system.	hardware and software.	color (using the *If/Else Block*). Partner B must be told which sound signals a correct answer and which signals an incorrect answer. See the example for red.  Have partners play the game, as Partner B prompts the sensor with a color and then uses the information to guess what color Partner A has chosen. Then have pairs switch. To conclude, ask students to describe the computing system parts that work together in the game. **SAY** *Connect a motor and the Color Sensor to your hub. Take turns playing a game with your partner. One of you will program the Color Sensor to play a sound if a chosen color is sensed and another sound if it doesn't sense that color. (Try using an If/Else Block.) Tell your partner which sound is for* correct *and which is for* incorrect. *Then play the game and guess each other's color. Now think about the parts of the game. How do the hub and Light Sensor work together? How does the Light Sensor use the program you created?* **MORE DETAILS** *The Color Sensor* tutorial in the START section of the SPIKE App, available on the web or downloaded.

		**Avoid the Edge**		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
39 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. **ENERGY**	• Explore and describe energy conversion (potential and kinetic energy). • Apply and test their existing scientific knowledge of energy conversion.	After students build the new game for the carnival, prompt them to use the Color Sensor to program it so the ball stops at the target. Lead discussion about what happens to the energy of the ball at different parts of the game. **SAY/ASK** *Leo notices a new game at the carnival. He's eager to try it and be the first to win. What about you? Try using different bats to make the ball stop at the target! What*

		NGSS 4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	• Engage effectively in a range of collaborative discussions.	*must happen to the ball's energy for it to stop? Where does the energy go?* **More Details** *Avoid the Edge* lesson or access in the LEGO® Education SPIKE™ App
40 🕒	**Prompt** **More with Math**	**Measurement and Data** **CCSS.MATH.Content.4.MD.A.1** Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.	• Record testing results in a two-column data table.	As your students play the *Avoid the Edge* game, have them measure and record the length of each trial with the chosen bat(s). Ask them to record their measurements in a two-column table for seconds and minutes. One column should record length in seconds and the other as minutes expressed in terms of seconds **Ask/Say** *What results did you get with Leo's game? Measure and record the length of each trial with different bats. Then make a two-column table for seconds and minutes. For each bat tested, record the length of the trial time in seconds and in minutes as a number of seconds.*

#	Activity Name	Topic(s) & Standards	Objectives Students will	Prompt
41 🕒	**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.	Provide code samples for practice debugging. Ask students to debug each code. See provided examples, explanations, fixes below or make your own.  **Example** *(Motor and sensor can't be plugged into the same port. Change one of the ports.)*  **Example** *(There's no Light Sensor in the model. Add a Light Sensor.)*

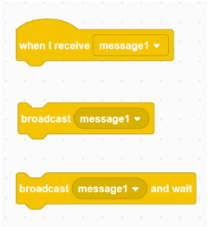
				 **Example** *(cannot take action based on Color Sensor until motor moves ball; Change the order of events in the code.)* **SAY/ASK** *Why do you think the code isn't working? Study each example to find the problem. Then fix it.*
42 PROMPT **More with ELA**		**READING LITERATURE** **CCSS.ELA-Literacy.RL.4.3** Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text (e.g., a character's thoughts, words, or actions). **READING SKILL PRACTICE: STORY EVENTS** **SEQUENCES** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.	• Describe the events in a story with specific details. • Modify the ending of a story. • Use Sound Blocks and Background Cards to add settings and events to a story.	Share that students have built models in response to many stories about Maria, Daniel, Sofie, and Leo as the friends travel to different settings. Prompt students now to build an alternative ending to one of those stories. Have them use the sounds and background cards in the LEGO® Education SPIKE™ App to add settings and interest to their story. As needed, show them how to access background cards by adding the Display extension. (Click the small + at the lower left of the programming canvas.) **SAY/ASK** *You've helped Maria, Daniel, Sofie, and Leo solve problems in stories within many different settings. But what if a story had a different ending? Choose one story and make a new ending. Use the background cards and sounds in your SPIKE App to add settings and interest to the story.* **MORE DETAILS** *Display Extension* (+ menu on the programming canvas); *Display Blocks* in the Help section of the SPIKE App, available on the web or downloaded.

	**Junior Pinball**		
#	**Activity Name**	**TOPIC(S) & Standards**	**Objectives** Students will	**Prompt**
43 LESSON		**ENERGY: SPEED AND COLLISIONS** **NGSS 4-PS3-4** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	• Apply their ideas to refine a solution that converts energy from one form to	After students build the junior pinball model, have them program it to start. Then prompt them to modify their

		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.	another. • Test the solution to improve and refine its function. • Engage effectively in a range of collaborative discussions.	program to make the game more unpredictable. Along the way, ask questions about energy. **SAY/ASK** *Sofie finds a game she doesn't recognize. It's a junior pinball game. Build the game and then program it to play. Improve the game to be more unpredictable. What changes did you make to how or when the game converted potential energy to kinetic energy? How did the different obstacles impact the energy conversion?* **MORE DETAILS** *Junior Pinball* lesson or access in the LEGO® Education SPIKE™ App
44 **PROMPT** **More with Math**		**GEOMETRY** **CCSS.MATH.Content.4.G.A.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. **MODIFY PROGRAMS** **CSTA 3-5 1A-DA-05** Store, copy, search, retrieve, modify, and delete information using a computing device and define the information stored as data. **DESIGN ENGINEERING** **NGSS 3-5 ETS 1-3** 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.	• Revise a pinball game for symmetry across the board. • Test to determine how the symmetry changes the experience of playing the game.	Have students redesign their pinball game to ensure there is symmetry across the board. Let students test the model to see if that changes the experience of playing the game. **SAY/ASK** *Remember our work with symmetry and buildings? Let's explore symmetry with Sofie's game. Redesign the model to make sure there is symmetry across the board. Then test it again. How, if at all, does the symmetry change the experience of playing the game?*
45 **PROMPT** **More with ELA**		**INFORMATIVE WRITING** **CCSS.ELA-Literacy.W.4.2.D** Use precise language and domain-specific vocabulary to inform about or explain the topic.	• Use research sources to learn about rules of pinball games. • Write directions for how to play their pinball game, including rules for scoring points and winning.	Have your students research the rules of pinball and write the rules for their own junior pinball games, including how to score points and win. Provide appropriate research sources. **SAY** *Now that you've made your own pinball game, tell people how to play it. First, learn about the rules for other pinball games. Then write directions for your game. Include the rules for how to score points and win the game.*

		**Energy Resources**		
#	**Activity Name**	**Topic(s) & Standards**	**Objectives** Students will	**Prompt**
46 🕒 🕒	**Lesson**	**Renewable and Non-Renewable Resources** **NGSS 4-ESS3-1** Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. **Design Engineering** **NGSS 3-5 ETS 1-1** 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-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.	• Use research to explain how humans use renewable and non-renewable energy resources from nature. • Use research to describe the positive and negative effects on the environment of using renewable vs. non-renewable resources. • Build a model to show one renewable energy resource.	Have students research to learn about renewable energy resources, using at least two sources that you provide. Then have them build and program a model that shows their learning about one type of renewable energy resource. **Say/Ask** *Sofie finds a wind turbine. She wonders how it gets energy. Learn about renewable energy like wind turbines. How do they help us get energy from nature to use again and again? Build and program one to show what you learned. It can be a wind turbine or any resource you found.* **More Details** *Energy Resources* lesson or access in the LEGO® Education SPIKE™ App
47 🕒	**Prompt** **More with Math and ELA**	**Geometry** **CCSS.MATH.Content.4.G.A.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. **Language** **CCSS.ELA-Literacy.L.4.6** Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal precise actions, emotions, or states of being (e.g., quizzed, whined, stammered) and that are basic to a particular topic (e.g., wildlife, conservation, and endangered when discussing animal preservation).	• Identify perpendicular and parallel lines in a model or image of a wind turbine. • Use domain-specific geometry language to explain observations.	Looking at the wind turbine in a model or the lesson images, have students identify perpendicular and parallel lines. Lead discussion in how the lines change as the model moves. **Say/Ask** *Look at Sofie's wind turbine model. Where do you see perpendicular or parallel lines? How do the lines change as the model moves?*
48 🕒	**Prompt** **More with ELA**	**Research for Writing** **CCSS.ELA-Literacy.W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic.	• Research to learn about negative impacts of using renewable and/or non-renewable resources on the environment.	Provide research sources (see the lesson for ideas). Have students use them to learn ways that humans can reduce the negative impacts of using renewable and/or non-renewable energy resources on the environment. Prompt them to share their findings through a brief video or written document.

		Speaking and Listening **CCSS.ELA-Literacy.SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.	• Use a video or other visual display to present learning.	**Say/Ask** *Research to learn about ways that people can avoid problems from using renewable and/or non-renewable energy resources. For example, how does each category of resources affect the environment? Share your findings in writing or with a video.*

#	Activity Name	Topic(s) & Standards	Objectives Students will	Prompt
49 🕒	**Prompt** **More with Computer Science**	**Sequences** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals.	• Investigate broadcast blocks and their use in a word block program.	As preparation for the final open-ended lesson *Creative Carnival Games*, have students explore ways to use the Broadcast Blocks in their LEGO® Education SPIKE™ App.  **Say/Ask** *Get ready for an exciting activity to make your own carnival game. Explore the Broadcast Blocks in your SPIKE App. How can they help you make your carnival game even more fun for Maria, Leo, Daniel, and Sofie?* **More Details** *When I Receive, Broadcast Message,* and *Broadcast Message and Wait Blocks* (Event Blocks) in the Help section of the SPIKE App, available on the web or downloaded.

Creative Carnival Games

#	Activity Name	Topic(s) & Standards	Objectives Students will	Prompt
50 🕒 🕒 🕒	**Lesson**	**Energy: Speed and Collisions** **NGSS 4-PS3-1** Use evidence to construct an explanation relating the speed of an object to the energy of that object. **NGSS 4-PS3-3** Ask questions and predict outcomes about the changes in energy that occur when objects collide.	• Apply their existing scientific knowledge of energy transfer and collision to solve a problem. • Engage effectively in a range of collaborative discussions.	Have students create a new carnival game for Sofie, Daniel, Leo, and Maria to play. Prompt them to use at least one motor or sensor (e.g., Color Sensor). Provide additional materials and encourage brainstorming to generate multiple solutions. Then have students build and program their game. **Say/Ask** *Create a new carnival game for the Spike team to play. Brainstorm with classmates to think of several ideas.*

		ENERGY: TRANSFER AND TRANSFORMATION **NGSS 4 PS3-2** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. **NGSS 4-PS3-4** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. **COMPUTATIONAL THINKING** **CSTA 3-5 1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate. **SEQUENCES** **CSTA 3-5 1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **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. **DATA ANALYSIS** **CSTA 3-5 1B-DA-07** Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.		*Then build and program your game. Use at least one motor or sensor.* **MORE DETAILS** *Creative Carnival Games* lesson or access in the LEGO® Education SPIKE™ App
51 🕒	**PROMPT** **More with ELA**	**INFORMATIVE WRITING** **CCSS.ELA-Literacy.W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. **CCSS.ELA-Literacy.W.4.2.D** Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.	• Write a description of the energy transfer in a carnival game. • Explain where the transfer of energy occurs, how it occurs, and how collision impacts the game. • Include specific details such as facts and examples.	Have students write descriptions of their carnival games, clearly stating where the transfer of energy occurs, how it occurs, and how collision impacts the game. **SAY** *Now that you've created a carnival game, explain what it shows about energy. Describe where the transfer of energy happens and how it occurs. Explain how collisions impact the game. Write your ideas, making sure to include specific facts and examples to explain your understanding.*