**LEGO® Education
Professional Development:**

Curriculum Integration Guide

LEGO® Education SPIKE™ Essential

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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 guide and learn more about LEGO Education's pedagogy, lesson structures, and some ways to support your learners.

Ways to Use the Guide

Use the table below to understand more about the supports in the guide and ways that different educators can use them.

When	Who	Why	How
Beginning of the year	Administrators, coaches, and planners	To choose which LEGO Education content to use for which grade levels, subjects, and topic areas	Use the Integrating Topics and Lessons Charts to map LEGO Education content to other curricular areas and resources.
		To support lesson planning	Provide the Integrating Topics and Lessons Charts and Lesson Planning Protocol to teachers and coaches.
		To inform plans for professional development and teacher support	Read this Introduction section to understand the pedagogy, lesson structure, and supports for all learners embedded in LEGO Education content.
	Teachers and instructional coaches	To understand what to expect in LEGO Education lessons	Read this Introduction section to understand the pedagogy, lesson structure, and supports for all learners embedded in LEGO Education content.
		To understand how to integrate LEGO Education lessons into other curricula and create plans for teaching them	Read the completed Lesson Planning Protocol Exemplar.
Year-round, e.g., during unit planning	Teachers and instructional coaches	To choose a lesson that aligns with your other curricula and determine when/how to integrate it into a sequence of instruction	Choose a lesson and plan sequencing using the Integrating Topics and Lessons Charts.
		To plan the details of a LEGO Education lesson, including how to differentiate, what to observe during instruction, and logistical details for all types of learners	Use the Lesson Planning Protocol and the Integrating Topics and Lessons Charts to plan lessons that meet your students' needs.

Pedagogy

Hands-On Learning

LEGO® Education content is designed to stimulate curiosity, develop problem-solving skills, and provide opportunities for engaged, hands-on learning in the service of standards-based learning. LEGO Education lessons incorporate collaboration and discovery-based learning to bring concepts to life in the classroom. Hands-on learning not only sparks student interest and motivation, but it also allows teachers to integrate authentic, real-world experiences into academic subjects. The teamwork, trial and error, and negotiation involved in collaborative hands-on learning help develop the communication and problem-solving skills that students will need in school, their careers, and everyday life.

Learning Through Play

Play-based learning and approaches such as inquiry-based learning and active and experiential learning are founded on similar learning theories. Central to these theories is the idea that educators and learners work together in variable partnerships to co-construct knowledge and leverage children's natural curiosity. Learning environments are intentionally designed to maximize opportunities to foster creativity, social interaction, experimentation, and a love of learning. Research shows the effectiveness of learning through play in many contexts, including school.[1]

Learning Through Iteration

"I have not failed. I've just found ten thousand ways that won't work."
—Thomas Edison

To discover and learn, scientists investigate. They gain information when investigations succeed as expected and when they "fail." Student scientists thus benefit from discovering, iterating, testing, observing, and getting stuck and unstuck—all vital stages in both project-based learning and the scientific process. These experiences offer precious opportunities to learn from what didn't work and from finding ways to solve problems, rather than from receiving a solution from the teacher. It is therefore important to target scaffolding on equitable access and removing insurmountable obstacles, allowing students the space in which to discover and learn.

Lesson Structure

LEGO Education lessons are built around the 5E Instructional Model, which reflects a journey through the stages of Engage, Explore, Explain, Elaborate, and Evaluate. Lesson plans include step-by-step guidance through each of the five stages.

- **Engage:** This introduction engages students' interest, activates background knowledge, and poses the problem or task of the lesson.
- **Explore:** In the body of the lesson, student pairs or small groups explore questions and problems and then design a solution or share findings related to the posed task.
- **Explain:** Students explain their findings and/or designs to the class, reflect on difficulties and how they solved them, and summarize their learning.
- **Elaborate:** Students expand and elaborate on their learning with further creative work. This may include additional aspects of a standard

or deeper work with the existing learning.
- **Evaluate:** Student learning is evaluated using a range of tools, such as rubrics, observation checklists, and self- and peer assessment routines.

In addition to the 5E Instructional Model, LEGO Education lessons include:
- **Teacher support** that lists key objectives, educational standards, and required materials
- **A Prepare** section that lists advance steps to complete
- Differentiation opportunities
- Extension ideas

Supporting All Learners

Different Learning Modalities and Modes

By its nature, hands-on learning supports diverse learning modalities and modes. LEGO® Education activities make use of students' visual/spatial, kinesthetic, and creative thinking skills, thus accommodating different learning styles and bringing concepts to life for all students.[2] To provide even more support, consider:

- Providing visual anchor charts to remind all students of protocols or task components (Make individual copies as needed to support executive functioning.)
- Assigning learning management roles within the class or for each small group, such as timekeeper, materials manager, and data recorder, rotating the roles
- Partnering students intentionally

1   Rachel Parker, Bo Stjerne Thomsen, and Amy Berry, "Learning Through Play at School – A Framework for Policy and Practice," CONCEPTUAL ANALYSIS article, Frontiers in Education, 17 February 2022: https://doi.org/10.3389/feduc.2022.751801.
2   Parker, Thomsen, and Berry, "Learning Through Play at School."

**Supporting Multi-Lingual/
English Language Learners (MLLs/ELLs)**

LEGO® Education lessons offer rich opportunities to develop both academic and social language skills in a purposeful setting. Students must use language to negotiate with each other, to decide how to approach their task, to give directions, to ask and answer questions, and to explain their work and discoveries. As students use language to solve problems and work together, their vocabulary and ability to express complex concepts will grow accordingly. Because it reflects a different kind of learning, the hum of a project-based learning lesson will sound different to teachers and students than the typical, quieter reading or seatwork-based lesson.

Teachers can support MLL/ELLs by:

- Providing visual charts
- Supplying word banks or charts with important terms for the learning domain
- Modeling and encouraging the use of specific language
- Providing opportunities for all students to reflect aloud on their learning and work

Professional Development Suggestions

LEGO Education lessons are designed for exploratory, hands-on learning. This kind of learning provides huge benefits for students as they deepen conceptual understanding while developing problem-solving and collaboration skills. Teachers can often benefit from targeted professional development that helps them meaningfully guide open-ended learning settings and experiences. Some possible options for professional development might include:

- Competency courses, targeting four main competency categories: STEAM Concepts,

21st Century Skills, Pedagogy, and Classroom Management. These self-guided online courses are designed to help teachers learn, practice, and apply the necessary competencies to facilitate playful, hands-on STEAM learning.

- Product support video tutorials to help teachers feel comfortable using a LEGO Education product with their students. The self-guided online videos cover preparing the sets for first use, guided lessons, tips for troubleshooting with the software and hardware, and programming and coding tips.
- Facilitated training courses led by a certified LEGO Education teacher trainer. These virtual or on-site courses are engaging learning experiences that build teachers' knowledge and competence with an individual LEGO Education product.
- Coaching programs that help to continuously build effective teaching practices for delivering hands-on STEAM learning. Led by a certified LEGO Education coach, this program focuses on transferring professional learning to individual classroom environments.

(To learn more about our key pedagogy, as well as professional development options and access to the LEGO Education Professional Development platform, visit this LEGO Education Professional Development resources page.)

Integrate Topics and Lessons with Your Curriculum

Use the Integrating Topics and Lessons Charts

Choose the directions below according to your educational role and planning purpose.
See Ways to Use the Guide for additional guidance.

Administrators, Coaches, and Curriculum Planners
Use these steps to choose which LEGO® Education content to use for which grade levels, subjects, and topic areas in your curricula.

When: Beginning of the year
How:

1. Choose subjects (e.g., science, design engineering, computer science) to which you'll add hands-on learning. Find the chart(s) for the relevant subject area(s).
2. Scan or use hyperlinks to locate grade levels of interest. Lessons appear in order by grade level, but you may wish to scan adjacent grades for suitable content. They also appear with each relevant subject area, with details pertinent to the learning.
3. Scan the first three columns for topics that match your grade-level units or standards within each subject area. Use the fourth column to understand the lesson further (if needed).
4. Write matches in a table like the example on the next page or in your own curriculum planning documents. (Use the *purple* entries in the Example chart to support your work.)

Teachers, Coaches, and Curriculum Planners
Use these steps to choose a specific LEGO Education lesson and decide where/how to integrate it with other curricular content or lesson sequences.

When: During unit planning
How:

1. Find your desired subject area (e.g., science, design engineering, computer science) in the charts. Scan or use hyperlinks to locate grade levels of interest.
2. Scan column A for the topic you are planning. (Lessons may appear under multiple subject areas, with details pertinent to the learning.)
3. Review the available standards (column B) and target grade/LEGO Education lessons (column C) to choose lessons that fit your instructional sequence.
4. Scan columns C and D to determine if the lesson requires adjustment for your class. (For example, a lesson with a target of grade 1 may need to be slightly adjusted for a grade K or grade 2 class. An Advanced lesson in the unit progression might need scaffolding. See Example chart entries in *purple*.)
5. Consult columns C and E to determine difficulty level and any prerequisite knowledge and skills to teach before the LEGO Education lesson. This may impact where you place the lesson in the sequence of your curriculum.
6. Write Lesson Integration Notes in a table like the example on the next page or in your own curriculum planning documents. (See Example chart entries in *purple*.)
7. Use your notes alongside the Lesson Planning Protocol to plan the details of lesson instruction.

Example Charts with Sample Notes for LEGO® Education SPIKE™ Essential lessons

Subject: PHYSICAL SCIENCE					
A. Topic	**B. Target Educational Standards (e.g. NGSS, CSTA)**	**C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)**	**Columns D–F ***	**Grade, Subject Area, & Topic Match**	**Lesson Integration Notes**
Light	**NGSS** 1-PS4–3 Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.	See It! Hear It! Build It! Lesson 3: *Transparency* (Grade 1: Intermediate)		*Grade 1, Science: Light unit*	*Teach after intro to light lessons 1–3 in science curriculum. Teach before beginning how-to books in ELA. Gather art materials. Consider teaching with or after the Beginner level Lesson 1: Illumination in the LEGO Education unit.*

Subject: **LIFE SCIENCE**					
Pollination & Seed Dispersal	**NGSS** 2-LS2–2 Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants	Science in Nature and Our Daily Life Lesson 3: *Pollination* (Grade 2: Intermediate)		*Grade 2, Science: Pollination lesson*	*Locate labeled plant diagram and pollination videos; Gather learning materials for Extension if using*
Plant & Animal Life Cycles	**NGSS** 3-LS1–1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.	Animals and Their Environments Lesson 2: *Life Cycles* (Grade 3: Intermediate)		*Grade 3, Science: Life Cycles unit*	*Complete Hovering Helicopter lesson first; Plan groupings; consider how to present aging/death.*

Subject: **EARTH AND SPACE SCIENCE**					
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.	Science Connections Lesson 3: *Energy Resources* (Grade 4: Intermediate)		*Grade 4, Science: Resources unit*	*FLAG: May need to clarify differences between the model and the way real wind turbines work. Find research sources.*
Planets, Solar System	**NGSS** 5-ESS1–2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	Science We Cannot See Lesson 3: *Daytime and Night-time* (Grade 5: Intermediate)		*Grade 5, Science: Solar System unit*	*Find reliable data; plan a way to check student data*

* Omitted in the Example Charts to create space for sample notes.

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Integrating Topics and Lessons Charts

For LEGO® Education SPIKE™ Essential lessons

Subject: Physical Science Grade 1 Grade 2 Grade 3 Grade 4 Grade 5					
A. Topic	**B.** Target Educational Standards (e.g., NGSS, CSTA)	**C.** LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	**D.** Activity of Lesson	**E.** Assumed Skills and Knowledge	**F.** • LEGO® Elements • Tools and Materials
Physical Science—Grade 1 (Back to top of PHYSICAL SCIENCE)					
Waves: Sound	**NGSS** 1-PS4–1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	See It! Hear It! Build It! Lesson 2: *Musical Vibrations* (Grade 1: Intermediate)	Plan and conduct investigations with a drum model to test and generate evidence showing that vibrating materials produce sound.	• Plan and conduct investigations. • Vibration is a rapid back and forth motion. • Vibrations can produce sound and, conversely, sound can produce vibrations.	• Musical instruments to demonstrate and test (drum, triangle, tuning fork, xylophone, guitar, piano, or flute) • Elastic bands, paper cups, shallow bowls to hold ½" of water • Paper logs with hour and half-hour marks
Waves: Light	**NGSS** 1-PS4–2 Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.	See It! Hear It! Build It! Lesson 1: *Illumination* (Grade 1: Beginner)	Use a flashlight model in a darkened space to observe and explain if an object can be seen with or without light.	• Are comfortable working in a darkened space • Make observations. • Support an account. • Light travels through the air. Some objects make light, while others do not.	• LEGO® Education SPIKE™ Essential light matrix • Pinhole box • Cellophane or other transparent, disposable material (for eye safety)
		Great Adventures Lesson 3: *Cave Car* (Grade 1: Intermediate)	• Build a car model with a light to illuminate a darkened space. • Use the model to construct an evidence-based account that objects in darkness can be seen only when illuminated.	• Are comfortable working in a darkened space • Make observations. • Support an account. • Light travels through the air. Some objects make light, while others do not.	• SPIKE™ Essential light matrix • SPIKE™ Essential programming blocks: 3×3 Light, Loop, Wait for and Display Blocks. • A darkened space

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, Lesson Title	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Waves: Light	**NGSS** 1-PS4–3 Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.	See It! Hear It! Build It! Lesson 3: _Transparency_ (Grade 1: Intermediate)	Plan and conduct investigations with the light matrix to test how different materials affect light (level of transparency)	• Plan and conduct investigations. • Are comfortable working in a darkened space • Record data from observations; Sort and categorize. • Light travels through the air. • Materials affect light beams differently.	• LEGO® Education SPIKE™ Essential light matrix • Classroom items comprised of materials that are transparent (a drinking glass, clear plastic ruler, or windowpane), translucent (wax paper, parchment paper, tissue paper), and opaque (cardboard, wood, metal) • Sorting supports (e.g. labeled boxes)
	NGSS 1-PS4–4 Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.	See It! Hear It! Build It Lesson 4: _Communicate with Light or Sound_ (Grade 1: Intermediate)	Design and build devices to communicate over a distance, one with light and one with sound.	• Design process, including sketches and iteration • Designing devices that create sound • Light and sound can travel over a distance. • People use codes to send messages over distances.	• SPIKE™ Essential light matrix; Sound and Light Blocks • Images of lighthouses and traffic lights
		Great Adventures Lesson 4: _Animal Alarm_ (Grade 1: Intermediate) Also see FIRST LEGO League Explore—_Explore Lesson 2_ (Grades 1–5: Beginner)	Design a device that uses light or sound to communicate over distance as an alarm when animals come at night.	• Design process, including sketches and iteration • Designing devices that create sound • Light and sound can travel over a distance • The function of the color sensor	• SPIKE™ Essential light matrix, color sensor • SPIKE™ Essential Programming blocks: Sound and Light Blocks
	NGSS 1-PS4–2 **NGSS** 1-PS4–4	Great Adventures Lesson 7: _The Great Desert Adventure_ (Grade 1: Advanced) **OPEN PROJECT**	• Build a model to help Daniel, Leo, Sofie, and Maria reach the pyramids. • Open-project activity that combines the learning acquired during the _Great Adventures_ unit 1. _Boat Trip_ 2. _Arctic Ride_ 3. _Cave Car_ 4. _Animal Alarm_ 5. _Underwater Quest_ 6. _Treehouse Camp_	Open-project activity that combines the knowledge/ skills acquired during the Great Adventures unit.	Open-project activity that combines the building/ programming skills acquired during the Great Adventures unit. See instructions or samples in the unit lessons for support.

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Forces and Motion; Pushes and Pulls	**NGSS** K-2-ETS1–1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	Great Adventures Lesson 1: *Boat Trip* (Grade 1: Beginner)	• Ask questions and make observations to determine how to push the boat. • Develop and improve the solution to solve the defined problem and push the boat further.	• Design process, including sketching and iterating • Ask questions about a defined problem. • People can develop/create tools to solve problems.	LEGO® Education SPIKE™ Essential Motor; Motor and Sound Blocks
	NGSS K-2-ETS1–2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem	Great Adventures Lesson 5: *Underwater Quest* (Grade 1: Intermediate)	Design a submarine to illustrate how the shape of an object helps it function as needed to solve a given problem.	• Design process, including sketching, and iteration • Use physical materials to design a solution. • Underwater transportation	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Control Block – repeat loop; forever loop.
	NGSS K-2-ETS1–1 **NGSS** K-2-ETS1–2 **NGSS** K-2-ETS1–3	Great Adventures Lesson 7: *The Great Desert Adventure* (Grade 1: Advanced) **OPEN PROJECT**	• Build a model to help Daniel, Leo, Sofie, and Maria reach the pyramids. • Open-project activity that combines the learning acquired during the *Great Adventures* unit 1. *Boat Trip* 2. *Arctic Ride* 3. *Cave Car* 4. *Animal Alarm* 5. *Underwater Quest* 6. *Treehouse Camp*	Open-project activity that combines the knowledge/ skills acquired during the Great Adventures unit.	Open-project activity that combines the building/ programming skills acquired during the Great Adventures unit. See instructions or samples in the unit lessons for support.

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Physical Science—Grade 2 (Back to top of PHYSICAL SCIENCE)					
A. Topic	**B. Target Educational Standards (e.g., NGSS, CSTA)**	**C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)**	**D. Activity of Lesson**	**E. Assumed Skills and Knowledge**	**F.** • LEGO® Elements • Tools and Materials
Properties of Matter	**NGSS** 2-PS1–1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	Science in Nature and Our Daily Life Lesson 4: *Classify and Choose Materials* (Grade 2: Intermediate)	• Plan and conduct investigations to observe and classify provided materials by their properties. • Use results to select materials to build a model.	• Collect and record observations and data. • Classify/categorize. • Work in groups and exchange findings. • Properties of different materials (soft, hard, strong, etc.) • Chicken coops or similar structures keep animals safe and comfortable.	• LEGO® Education SPIKE™ Essential Event, motor and color sensor; Motor and Color Sensor Programming blocks • Box of assorted craft materials sortable by properties • Recycled materials such as used paper, paper cups, plastic like straws or bottles, or glass bottles
Structure and Properties of Matter	**NGSS** 2-PS1–3 Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.	Science in Nature and Our Daily Life Lesson 2: *Redesigning Make New Objects.* (Grade 2: Intermediate)	• Build a model of a kitchen tool and then disassemble it to build a second tool from the same pieces. • Observe and explain.	• Make observations. • Support an account. • Common kitchen tools. • Properties of different materials (soft, hard, strong, etc.)	• Boxes of 10 varied basic SPIKE™ Essential elements • Pictures of different kitchen tools • One small cup per pair
Forces and Motion	**NGSS** K-2-ETS1–1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	Amazing Amusement Park Lesson 2: *Classic Carousel* (Grade 2: Intermediate)	• Ask questions and make observations about how to make a carousel spin differently. • Improve the solution by modifying the prototypes.	• Ask questions about a defined problem. • Design process: iterating prototypes • Common rides in an amusement park	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Wait for, Display, Loop and Sound Blocks
		Amazing Amusement Park Lesson 5: *Twirling Teacups* (Grade 2: Intermediate)	• Ask questions and make observations to investigate how new seats on a spinning ride will move. • Improve the solution by modifying the prototypes.	• Ask questions about a defined problem. • Design process: iterating prototypes • Common rides in an amusement park	• SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Motor, Event, Loop and Sound Blocks
	NGSS K-2-ETS1–2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	Amazing Amusement Park Lesson 3: *The Perfect Swing* (Grade 2: Intermediate)	• Design to make a swing move differently, so that it doesn't go fast and fits two people. • Predict the motion of the swing when making design changes.	• Design process, including sketching, and iteration • Using physical materials to design a solution. • Common rides in an amusement park	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Loop and Sound Blocks

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Forces and Motion	**NGSS** K-2-ETS1–3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	Amazing Amusement Park Lesson 6: *The Spinning Ferris Wheel* (Grade 2: Intermediate)	• Program to change the Ferris wheel's motion so it stops to let riders get on. • Compare the different solutions for making the Ferris wheel better and be able to explain their strengths and weaknesses.	• Read graphical displays (tables, pictographs, line plots). • Test and observe design solutions. • Common rides in an amusement park • The function of light matrixes	• LEGO® Education SPIKE™ Essential light matrix • SPIKE™ Essential Programming blocks: Motor, Event, 3×3 Light, Loop, Wait for, Sound and Random Blocks
	NGSS K-2-ETS1–1 **NGSS** K-2-ETS1–2 **NGSS** K-2-ETS1–3	Amazing Amusement Park Lesson 7: *The Most Amazing Amusement Park* (Grade 2: Advanced) **OPEN PROJECT**	• Build a model that moves to add a new ride to the amusement park. • Open-project activity that combines the learning acquired during the *Amazing Amusement Park* unit. 1. *Fast Lane* 2. *Classic Carousel* 3. *The Perfect Swing* 4. *Snack Stand* 5. *Twirling Teacups* 6. *The Spinning Ferris Wheel*	• Open-project activity that combines the knowledge/ skills acquired during the Amazing Amusement Park unit.	• Open-project activity that combines the building/ programming skills acquired during the Amazing Amusement Park unit. See instructions or samples in the unit lessons for support.

Physical Science—Grade 3 (Back to top of PHYSICAL SCIENCE)					
A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Forces and Motion	**NGSS** 3–5-ETS1–1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	Happy Traveler Lesson 1: *River Ferry* (Grade 3: Beginner)	• Design and build a ferry model that moves. • Modify it based on a defined design problem to help Daniel have a fun ferry ride.	• Design process: sketching and iterating • Design criteria and constraints	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Display and Sound Blocks

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, Lesson Title	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Forces and Motion	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.	Happy Traveler Lesson 2: _Taxi! Taxi!_ (Grade 3: Intermediate)	Design a taxi model that meets the necessary criteria and constraints, including moving to follow different routes.	• Design process: sketching and iterating • Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions	• LEGO® Education SPIKE™ Essential motor (x2) • SPIKE™ Essential Programming blocks: Movement and Wait for Blocks
		Happy Traveler Lesson 5: _Cable Car_ (Grade 3: Intermediate)	• Design a cable car model that meets the necessary criteria and constraints, including repeated motion from one side to the other side. • Predict motion to support design success.	• Design process: sketching and iterating • Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Wait for, Display and Sound Blocks
	NGSS 3–5-ETS1–3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Happy Traveler Lesson 3: _Hovering Helicopter_ (Grade 3: Intermediate)	Build and program a helicopter model, including moving differently when tilted.	• Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions • Collect and record data	• SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Event, Display and Wait for Blocks
	NGSS 3–5-ETS1–1 NGSS 3–5-ETS1–2 NGSS 3–5-ETS1–3	Happy Traveler Lesson 7: _Get Around Town_ (Grade 3: Intermediate) **OPEN PROJECT**	• Design and build a model to help Daniel, Leo, Sofie, and Maria reach the Spike castle. • Open-project activity that combines the learning acquired during the _Happy Traveler_ unit 1. _River Ferry_ 2. _Taxi! Taxi!_ 3. _Hovering Helicopter_ 4. _Swamp Boat_ 5. _Cable Car_ 6. _Big Bus_	Open-project activity that combines the knowledge/ skills acquired during the Happy Traveler unit.	Open-project activity that combines the building/ programming skills acquired during the Happy Traveler unit. See instructions or samples in the unit lessons for support.

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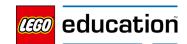|	Physical Science—Grade 4				
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A. Topic	**B. Target Educational Standards (e.g., NGSS, CSTA)**	**C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)**	**D. Activity of Lesson**	**E. Assumed Skills and Knowledge**	**F. • LEGO® Elements • Tools and Materials**
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	Crazy Carnival Games Lesson 1: *Mini Mini-Golf* (Grade 4: Beginner)	Build and use a mini-golf game to explain the relationship of an object's speed to its energy.	• Energy exists in moving objects. • Use measurements, observations, or patterns to construct an explanation.	• LEGO® Education SPIKE™ Essential motor and light matrix • SPIKE™ Essential Programming blocks: Motor, 3×3 Light and Sound Blocks
Energy; Energy Transfer and Transformations	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.	Crazy Carnival Games Lesson 3: *High Stick Hockey* (Grade 4: Intermediate)	Build a model hockey game and use it to make observations that provide evidence that the energy in the red ball can be transferred from place to place by changing the ball's direction.	Energy exists in moving objects.	• SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Loop, Wait For, Random and Sound Blocks
		Crazy Carnival Games Lesson 4: *A-Maze-ing* (Grade 4: Intermediate)	Build a maze model and use it to make observations that provide evidence that the energy in the red ball can be transferred from place to place by changing the ball's direction.	• Energy exists in moving objects. • Functions of light matrixes and Gyro Sensors	• SPIKE™ Essential light matrix, Gyro Sensor • SPIKE™ Essential Programming blocks: Event, 3×3 Light, Bar Graph and Sound Blocks
Energy; Speed and Collisions	NGSS 4-PS3–3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.	Crazy Carnival Games Lesson 2: *Bowling Fun* (Grade 4: Intermediate)	Build a bowling alley model. Use it to predict outcomes about changes in energy by positioning the rolling path at different heights.	• Energy exists in moving objects. • Energy transfers between objects.	• SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Wait For, Display, Random, and Sound Blocks
Energy; Energy Transformations	NGSS 4-PS3–4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another	Crazy Carnival Games Lesson 5: *Avoid the Edge* (Grade 4: Intermediate)	Build an avoid-the-edge game and use scientific ideas to upgrade, test and refine it to convert energy from one form to another.	• Energy exists in moving objects. • Energy transfers between objects. • Energy changes when objects collide.	• SPIKE™ Essential motor and color sensor • SPIKE™ Essential Programming blocks: Motor, Wait For, If Then/If Then Else, and Sound Blocks
		Crazy Carnival Games Lesson 6: *Junior Pinball* (Grade 4: Intermediate)	Build a pinball game and use scientific ideas to upgrade, test and refine it to convert energy from one form to another.	• Energy exists in moving objects • Energy transfers between objects. • Energy changes when objects collide.	• SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Loop, Wait For, Sound, Display and Random Blocks

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Top of chart　　Physical Science　　Life Science　　Earth and Space Science　　Design Engineering　　Computer Science　　*FIRST* LEGO League

LEGO education™

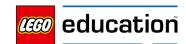| A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Energy	**NGSS** 4-PS3–1 **NGSS** 4-PS3–2 **NGSS** 4-PS3–3 **NGSS** 4-PS3–4	Crazy Carnival Games Lesson 7: *Creative Carnival Games* (Grade 4: Advanced)　　**OPEN PROJECT**	• Build a model to add a new game to the carnival. • Open-project activity that combines the learning acquired during the *Crazy Carnival Games* unit. 1. *Mini Mini-Golf* 2. *Bowling Fun* 3. *High Stick Hockey* 4. *A-Maze-ing* 5. *Avoid the Edge* 6. *Junior Pinball*	Open-project activity that combines the knowledge/ skills acquired during the Crazy Carnival Games unit.	Open-project activity that combines the building/ programming skills acquired during the Crazy Carnival Games unit. See instructions or samples in the unit lessons for support.
Light Refraction & Vision	**NGSS** 4-PS4–2 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen	Science Connections Lesson 1: *How Eyes See* (Grade 4: Beginner)	Build a model of a movable light source and use it to describe how light reflected from objects enters the eye, allowing the object to be seen.	• Light travels to the eye, allowing the eye to detect light and color. • The retina is the part of the eye that detects light and color. • The eye sends signals to the brain, which uses this information so that we see objects.	• LEGO® Education SPIKE™ Essential light matrix • SPIKE™ Essential Programming blocks: Light Blocks • Darkened room/area or box for testing the model
Information Transfer; Patterns	**NGSS** 4-PS4–3 Generate and compare multiple solutions that use patterns to transfer information.	Science Connections Lesson 5: *Information Transfer* (Grade 4: Advanced)　　**OPEN PROJECT**	• Design two or more methods for transferring information with patterns (codes), and then build device(s) that use them. • Use criteria and constraints to test the solutions, and then to evaluate them for speed, accuracy, and ease of use. • Open-project activity that combines the learning skills acquired during the *Science Connections* unit. 1. *How Eyes See* 2. *Animal Structures* 3. *Energy Resources* 4. *Prepare for Natural Hazards*	• Open-project activity that combines the learning skills acquired during the Science Connections unit. • Design process, including sketching, criteria and constraints, iteration • Compare and contrast. • Evaluate with criteria.	• Open-project activity that combines the building/ programming skills acquired during the Science Connections Life unit. See instructions or samples in the unit lessons for support. • SPIKE™ Essential light matrix • SPIKE™ Essential Programming blocks: Light and Sound Blocks • Printed or digital example of Morse Code

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Physical Science—Grade 5					
(Back to top of PHYSICAL SCIENCE)					
A. **Topic**	**B.** **Target Educational Standards** **(e.g., NGSS, CSTA)**	**C.** **LEGO® Education Unit,** *Lesson Title* **(Target Grade, Level of Difficulty in the Unit)**	**D.** **Activity of Lesson**	**E.** **Assumed Skills and Knowledge**	**F.** • **LEGO® Elements** • **Tools and Materials**
Matter: Properties and Inter- actions	**NGSS** 5-PS1–1 Develop a model to describe that matter is made of particles too small to be seen.	Science We Cannot See Lesson 1: *Matter* (Grade 5: Beginner)	• Build a motorized fan that can blow over a paper tower. • Use it to explain that although air particles are too small to be seen, they are pushed by the fan against the paper to knock it over.	• Matter is the substance from which objects are made. • Wind is moving air. • Air is made of physical particles too small to be seen.	• LEGO® Education SPIKE™ Essential motor • SPIKE™ Essential Program- ming blocks: Event and Sensor Blocks • One-third sheet of white copy paper, folded as a tower • Scissors • Cardstock (optional)
Balanced and Unbalanced Forces; Gravity	**NGSS** 5-PS2–1 Support an argument that the gravitational force exerted by Earth on objects is directed down	Science We Cannot See Lesson 2: *Gravity* (Grade 5: Intermediate)	• Build a balancing bird model to demonstrate that the gravitation- al force exerted by Earth pulls objects down toward Earth's center. • Use it to explain the bird's be- havior in terms of the downward force of gravity.	• Forces are pushes or pulls that act in a specific direction. • Gravity is a force exerted by Earth that pulls objects down toward the center of the planet. • Elements of an argument	• SPIKE™ Essential Gyro Sensor • SPIKE™ Essential Program- ming blocks: Event and Sensor Blocks
Energy Transfer and Trans- formation	**NGSS** 5-PS3–1 Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	Science We Cannot See Lesson 5: *Energy Flow* (Grade 5: Advanced) **OPEN PROJECT**	• Build a model to show the flow of energy from sunlight to plants and then to animals. Use it to describe how animals get and use energy from the sun, and that energy in animals' food was once energy from the sun. • Open-project activity that com- bines the learning skills acquired during the *Science We Cannot See* unit. 1. *Matter* 2. *Gravity* 3. *Daytime and Nighttime* 4. *Protect the Environment*	• Open-project activity that com- bines the learning skills acquired during the Science We Cannot See unit. • Elements of an argument • Collaborate to build a shared model. • Energy is present in sunlight, plants, and animals. Plants use that energy to grow. Animals get it by eating plants (or other animals).	• Open-project activity that com- bines the building/ program- ming skills acquired during the Science We Cannot See unit. See instructions or samples in the unit lessons for support. • SPIKE™ Essential light matrix, motor, and other elements that can represent energy flow

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Forces and Motion	**NGSS** 3–5-ETS1–3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Quirky Creations Lesson 5: *Winning Goal* (Grade 5: Intermediate)	• Design and build a model like a computer game • Upgrade the game to make it more fun, including by predicting motion from possible changes.	• Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions. • Collect and record data.	• LEGO® Education SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Event, Display, Loop, Wait For, Random and Sound Blocks

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🏠 Top of chart   Physical Science   Life Science   Earth and Space Science   Design Engineering   Computer Science   FIRST LEGO League

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Subject: Life Science
Grade 1   Grade 2   Grade 3   Grade 4   Grade 5

A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Life Science—Grade 1 (Back to the top of LIFE SCIENCE)					
Structure and Function	**NGSS** 1-LS1–1 Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.	See It! Hear It! Build It! Lesson 5: *Using Ideas from Nature* (Grade 1: Advanced)	• Design a solution to a human problem using ideas from external animal structures (biomimicry). • Open-project activity that combines the learning skills acquired during the *See It! Hear It! Build It!* unit. 1. *Illumination* 2. *Musical Vibrations* 3. *Transparency* 4. *Communicate with Light and Sound*	• Open-project activity that combines the learning skills acquired during the See It! Hear It! Build It! Unit. • Design process, including sketches and iteration • External body parts are on the outside of the animal. • People use ideas from nature to create inventions.	• Open-project activity that combines the building/ programming skills acquired during the See It! Hear It! Build It! unit. See instructions or samples in the unit lessons for support. • LEGO® Education SPIKE™ Essential set • Age-appropriate scientific information, images, or video about 1) biomimicry and 2) animal body parts • Craft materials
		OPEN PROJECT			
Earth's Surface; Bodies of Water	**NGSS** K-2-ETS1–1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	Great Adventures Lesson 5: *Underwater Quest* (Grade 1: Intermediate)	Design a submarine to illustrate how the shape of an object helps it function as needed to solve a given problem.	• Design process, including sketching, and iteration • Use physical materials to design a solution. • Underwater transportation	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Control Block – repeat loop; forever loop

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Life Science—Grade 2 (Back to the top of LIFE SCIENCE)					
A. **Topic**	**B.** **Target Educational Standards (e.g., NGSS, CSTA)**	**C.** **LEGO® Education Unit,** *Lesson Title* **(Target Grade, Level of Difficulty in the Unit)**	**D.** **Activity of Lesson**	**E.** **Assumed Skills and Knowledge**	**F.** • **LEGO® Elements** • **Tools and Materials**
Pollination and Seed Dispersal	**NGSS** 2-LS2–2 Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants	Science in Nature and Our Daily Life Lesson 3: *Pollination* (Grade 2: Intermediate)	Design and build a model to mimic the process of pollen transfer from plant to animal.	• Design process, including iteration • Models can mimic a process from nature. • Most flowering plants need pollen from other plants to produce the seeds that grow into new plants. • Animals help spread pollen through direct contact with certain parts of plants.	• LEGO® Education SPIKE™ Essential Event Blocks to trigger sounds in a program • Age-appropriate learning videos about pollination • Age-appropriate labeled diagram of plant parts
Biodiversity; Habitats	**NGSS** 2-LS4–1 Make observations of plants and animals to compare the diversity of life in different habitats.	Science in Nature and Our Daily Life Lesson 1: *Habitats* (Grade 2: Beginner)	Build models that show important features of a habitat and use them to observe and compare the types of plants and animals that live in different habitats.	• Collaborate to build a shared model. • Make observations. • Compare and contrast. • Habitats are natural homes for plants and animals that supply what they need. • Common plants and animals in nearby or familiar habitats	• SPIKE™ Essential set • Age-appropriate books, materials, or online resources of different habitats • Craft materials

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Life Science—Grade 3 (Back to the top of LIFE SCIENCE)					
A. **Topic**	**B.** **Target Educational Standards** **(e.g., NGSS, CSTA)**	**C.** **LEGO® Education Unit,** *Lesson Title* **(Target Grade, Level of** **Difficulty in the Unit)**	**D.** **Activity of Lesson**	**E.** **Assumed Skills and Knowledge**	**F.** • **LEGO® Elements** • **Tools and Materials**
Plant & Animal Life Cycles	**NGSS** 3-LS1–1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.	Animals and Their Environments Lesson 2: *Life Cycles* (Grade 3: Intermediate)	Design and build a rotating platform with models showing four stages of an animal's life cycle (birth, growth, reproduction, and aging)	• Design process, including sketching and iteration • Collaborate in groups for shared goal. • Basic stages in plant and animal life cycles	• LEGO® Education SPIKE™ Essential Motor Blocks for rotation • Information or images of plant and animal life cycles
Ecosystems, Group Behavior	**NGSS** 3-LS2–1 Construct an argument that some animals form groups that help members survive.	Animals and Their Environments Lesson 3: *Animal Behavior* (Grade 3: Intermediate)	Build a model of different animals in a herd and use it to construct an argument that living in a group helps animals defend group members.	• Elements of an argument • Some animals live in groups in ways that benefit them, including warning each other of predators.	• SPIKE™ Essential Color Sensor • Graphing paper
Ecosystems; Habitats; Adaptations	**NGSS** 3-LS4–3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	Animals and Their Environments Lesson 5: *Animals in their Habitats* (Grade 3: Advanced) **OPEN PROJECT**	• Build a model animal and surrounding appropriate habitat and use it as evidence to make an argument about the animal's adaptation to its environment. • Open-project activity that combines the learning skills acquired during the *Animals and Their Environments* unit. 1. *Preparing for the Weather* 2. *Life Cycles* 3. *Animal Behavior* 4. *Solving Problems When Environments Change*	• Open-project activity that combines the learning skills acquired during the Animals and Their Environments unit. • Elements of an argument • Collaborate to build a shared model. • Features of common habitats	• Open-project activity that combines the building/programming skills acquired during the Animals and Their Environments unit. See instructions or samples in the unit lessons for support. • SPIKE™ Essential Motor • Age-appropriate resources and images about various North American habitats and the animals in them • Craft materials to enhance habitat models

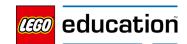| A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Ecosystems **Interdependent Relationships** **Human Impact on the Environment**	**NGSS** 3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.	Essential Combined Lesson 2: *Safe Crossing* (Grades 3–5: Advanced)	Build an automated crossing that lets animals and humans safely pass.	• Basic stages in plant and animal life cycles. • Common (nearby or familiar) habitats	• Activity Brief lesson that uses elements from two LEGO® Education sets. • LEGO® Education SPIKE™ Essential set • Hardware: motor and light matrix • Programming: Motor, Event, If Then, Loop, Wait For and Sensor Blocks. • LEGO® Education BricQ Motion Essential Set • SPIKE Essential bridge pins (optional)
		Animals and Their Environments Lesson 4: *Solving Problems When Environments Change* (Grade 3: Intermediate)	• Build a model that solves a problem for wetland animals when people build there. • Make and support a claim that the design solves the problem.	• Elements of a claim, including how it's supported with evidence and reasons • What a wetland is and what types of plants and animals live there (or another environment of your choosing) • Building in wetlands can change the environment in ways that affect the plants and animals living there.	• SPIKE™ Essential Motor • Information, images, and/or videos of wetlands (optional)

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Life Science—Grade 4
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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
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.	Essential Combined Lesson 1: *Create a Critter* (Grades 3–5: Advanced)	Design a model of a plant or animal with a structure or function to help it survive and grow.	• Design process, including sketching and iteration • Collaborate in groups for shared goal. • Basic stages in plant and animal life cycles	• Activity Brief lesson that uses elements from two LEGO® Education sets. • LEGO® Education SPIKE™ Essential Motor and Color Sensor • SPIKE™ Essential programming: Motor and Event Blocks • LEGO® Education BricQ Motion Essential Set • SPIKE Essential bridge pins (optional)
		Science Connections Lesson 2: *Animal Structures* (Grade 4: Intermediate)	• Build an elephant model with a movable trunk. • Use it to show how the trunk supports eating, drinking, bathing, or communicating, and as evidence to support an argument that the elephant's external and internal structures help it to survive.	• Animals have internal structures inside their bodies and external structures outside their bodies. • Elephant trunks have many functions that help elephants survive.	• SPIKE™ Essential Motor • SPIKE™ Essential programming: Motor, Sound, and Event Blocks • Craft materials (optional)

Life Science —Grade 5
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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Human Impact on the Environment	**NGSS** 3–5-ETS1–1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	Quirky Creations Lesson 4: *Trash Monster Machine* (Grade 5: Intermediate)	Build a model machine to collect and count trash of different colors, to encourage people to throw away their trash.	• Design process: sketching and iterating • Understand design criteria and constraints	• SPIKE™ Essential motor and color sensor. • SPIKE™ Essential Programming blocks: Motor, Event, Loop, Wait For, Display, Bar Graph, and Sound Blocks

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Subject: Earth and Space Science
Grade 1   Grade 2   Grade 3   Grade 4   Grade 5

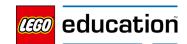| A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Earth/Space Science—Grade 1 (Back to the top of EARTH AND SPACE SCIENCE)					
Earth's Surface/ Landforms	**NGSS** 2-ESS2–1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.	Science in Nature and Our Daily Life Lesson 5: *Protection from Wind* (Grade 2: Advanced) **OPEN PROJECT**	• Design and build a solution to protect the soil at a park from wind, and then compare with other solutions in the class. • Open-project activity that combines the learning skills acquired during the *Science in Nature and our Daily Life* unit. 1. *Habitats* 2. *Redesigning to Make New Objects* 3. *Pollination* 4. *Classify and Choose Materials*	• Open-project activity that combines the learning skills acquired during the Science in Nature and our Daily Life unit. • Design process, including sketching and iteration • Compare and contrast; Evaluate with criteria • Wind causes weathering and erosion that changes the shape of landforms.	• Open-project activity that combines the building/ programming skills acquired during the Science in Nature and our Daily Life unit. See instructions or samples in the unit lessons for support. • LEGO® Education SPIKE™ Essential green elements for park plants • Age-appropriate resources about weathering and wind erosion • Craft materials
Weather and Climate	**NGSS** K-2-ETS1–2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	Great Adventures Lesson 2: *Arctic Ride* (Grade 1: Intermediate) Also see *FIRST* LEGO League Explore—*Explore Lesson 3* (Grades 1–5: Beginner)	Design and build a snowmobile to illustrate how the shape of an object helps it function as needed to solve a given problem (moving on the ice).	• Basic directions (left, right, forward, and backward) • Arctic habitat • Design process, including sketches, and iteration • Using physical materials to design a solution	• SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Movement and Display Blocks
		Great Adventures Lesson 7: *The Great Desert Adventure* (Grade 1: Advanced) **OPEN PROJECT**	• Build a model to help Daniel, Leo, Sofie, and Maria reach the pyramids. • Open-project activity that combines the learning acquired during the *Great Adventures* unit 1. *Boat Trip* 2. *Arctic Ride* 3. *Cave Car* 4. *Animal Alarm* 5. *Underwater Quest* 6. *Treehouse Camp*	Open-project activity that combines the knowledge/ skills acquired during the Great Adventures unit.	Open-project activity that combines the building/ programming skills acquired during the Great Adventures unit. See instructions or samples in the unit lessons for support.

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Sun and Other Stars Patterns Objects in the Solar System	**NGSS** K-2-ETS1–2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	Great Adventures Lesson 6: <u>Treehouse Camp</u> (Grade 1: Intermediate)	• Design a treehouse with a motorized opening roof to allow Sofie to see the sunset. • Observe the sun, moon, or stars by opening the treehouse roof.	• Design process, including sketches, and iteration • Use physical materials to design a solution. • The sun sets in the west.	• LEGO® Education SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Motor, Event and Display Blocks.

Earth/Space Science—Grade 2 (Back to the top of <u>EARTH AND SPACE SCIENCE</u>)					
A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Earth's Surface/ Landforms	**NGSS** 2-ESS2–1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.	Science in Nature and Our Daily Life Lesson 5: <u>Protection from Wind</u> (Grade 2: Advanced) **OPEN PROJECT**	• Design and build a solution to protect the soil at a park from wind, and then compare with other solutions in the class. • Open-project activity that combines learning skills acquired during the <u>*Science in Nature and our Daily Life*</u> unit. 1. *Habitats* 2. *Redesigning to Make New Objects* 3. *Pollination* 4. *Classify and Choose Materials*	• Open-project activity that combines the learning skills acquired during the Science in Nature and our Daily Life unit. • Design process, including sketching and iteration • Compare and contrast; Evaluate with criteria • Wind causes weathering and erosion that changes the shape of landforms.	• Open-project activity that combines the building/ programming skills acquired during the Science in Nature and our Daily Life unit. See instructions or samples in the unit lessons for support. • SPIKE™ Essential green elements for park plants • Age-appropriate resources about weathering and wind erosion • Craft materials

Earth/Space Science—Grade 3 (Back to the top of <u>EARTH AND SPACE SCIENCE</u>)					
Extreme Weather Solutions/ Preparedness	**NGSS** 3-ESS3–1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.	Animals and Their Environments Lesson 1: <u>Preparing for the Weather</u> (Grade 3: Beginner)	• Design and build a model pet house that can withstand impact of a selected weather-related hazard. • Use the model to support a claim about the problems and how the design addresses them.	• Elements of a claim, including evidence • Storms can cause damage from high winds, flooding, lightning, or snow. • Programming the gyro sensor	• SPIKE™ Essential gyro sensor, light matrix; Programming blocks: Event, Light, and Motor Blocks

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Earth/Space Science—Grade 4 (Back to the top of EARTH AND SPACE SCIENCE)					
A. **Topic**	**B.** **Target Educational Standards (e.g., NGSS, CSTA)**	**C.** **LEGO® Education Unit,** *Lesson Title* **(Target Grade, Level of Difficulty in the Unit)**	**D.** **Activity of Lesson**	**E.** **Assumed Skills and Knowledge**	**F.** • **LEGO® Elements** • **Tools and Materials**
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.	Science Connections Lesson 3: *Energy Resources* (Grade 4: Intermediate)	• Research renewable and non-renewable energy sources and describe pros and cons for one example. • Build a model to show learning.	• Work in a small group • Understand cause and effect • Differences between renewable vs. non-renewable resources	• LEGO® Education SPIKE™ Essential Event, Light, and Motor Blocks • Reliable, age-appropriate research sources for renewable and non-renewable energy resources (e.g., solar, wind, nuclear, and fossil fuels), human uses of these, and their environmental impacts • Images of windmills and wind turbines
Natural Disasters; Preparedness	**NGSS** 4-ESS3–2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	Science Connections Lesson 4: *Prepare for Natural Hazards* (Grade 4: Intermediate)	• Design and build a model structure and shaking machine. Use them to test structures that can withstand shaking to reduce the impact of earthquakes on humans. • Evaluate multiple designs and models to compare their effectiveness.	• Use criteria to evaluate • Compare and contrast • Earthquakes can cause the ground to shake violently, which can damage or destroy buildings.	• SPIKE™ Essential Event and Motor Blocks • Varied SPIKE™ Essential elements to create buildings with different shapes, sizes, and flexibility • Videos about earthquake shake tests

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Earth/Space Science—Grade 5 (Back to the top of EARTH AND SPACE SCIENCE)					
A. **Topic**	**B.** **Target Educational Standards (e.g., NGSS, CSTA)**	**C.** **LEGO® Education Unit,** *Lesson Title* **(Target Grade, Level of Difficulty in the Unit)**	**D.** **Activity of Lesson**	**E.** **Assumed Skills and Knowledge**	**F.** • **LEGO® Elements** • **Tools and Materials**
Planets, Solar System	**NGSS** 5-ESS1–2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	Science We Cannot See Lesson 3: *Daytime and Nighttime* (Grade 5: Intermediate)	• Use provided data about average sunrise/sunset times or average hours of daylight to find patterns and then present the data in graphical form. • Build a model lamp and program it to activate during hours of darkness required by the data.	• Make line graphs or pie charts, and determine the best uses for each kind. • Sunrise and sunset patterns throughout the year	• SPIKE™ Essential light matrix; Control and Light Blocks • Sunrise/sunset times or average monthly daylight hours from reliable government source; graphing paper; graphing/charting templates (optional)
Earth and Human Activity	**NGSS** 5-ESS3–1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	Science We Cannot See Lesson 4: *Protect the Environment* (Grade 5: Intermediate)	• Choose at least two research sources (from provided options) to research a way that communities use science to protect their environment. • Build a model that shows the learning.	Some familiarity with environmental actions such as recycling (additional knowledge will be built during the lesson research)	• SPIKE™ Essential set • Age-appropriate research sources for ways to use science to protect the environment • Craft materials (optional)

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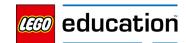
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Subject: Design Engineering
Grade 1   Grade 2   Grade 3   Grade 4   Grade 5

A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
		Design Engineering—Grade 1 (Back to the top of DESIGN ENGINEERING)			
Design Engineering	**NGSS** K-2-ETS1–1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	Great Adventures Lesson 1: *Boat Trip* (Grade 1: Beginner)	• Ask questions and make observations to determine how to push the boat. • Develop and improve the solution to solve the defined problem and push the boat further.	• Design process, including sketching and iterating • Ask questions about a defined problem. • People can develop/create tools to solve problems.	• LEGO® Education SPIKE™ Essential Motor; Motor and Sound Blocks
Design Engineering	**NGSS** K-2-ETS1–2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	Great Adventures Lesson 2: *Arctic Ride* (Grade 1: Intermediate) Also see *FIRST* LEGO League Explore—*Explore Lesson 3* (Grades 1–5: Beginner)	Design and build a snowmobile to illustrate how the shape of an object helps it function as needed to solve a given problem (moving on the ice).	• Basic directions (left, right, forward, and backward) • Arctic habitat • Design process, including sketches, and iteration • Using physical materials to design a solution	• SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Movement and Display Blocks
		Great Adventures Lesson 5: *Underwater Quest* (Grade 1: Intermediate)	Design a submarine to illustrate how the shape of an object helps it function as needed to solve a given problem.	• Design process, including sketching, and iteration • Use physical materials to design a solution. • Underwater transportation	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Control Block – repeat loop; forever loop.
		Great Adventures Lesson 6: *Treehouse Camp* (Grade 1: Intermediate)	Design a treehouse with a motorized opening roof to allow Sofie to see the sunset.	• Design process, including sketches, and iteration • Use physical materials to design a solution. • The sun sets in the west.	• SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Motor, Event and Display Blocks.

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Design engineering	**NGSS** K-2-ETS1–1 **NGSS** K-2-ETS1–2 **NGSS** K-2-ETS1–3	Great Adventures Lesson 7: *The Great Desert Adventure* (Grade 1: Advanced) **OPEN PROJECT**	• Build a model to help Daniel, Leo, Sofie, and Maria reach the pyramids. • Open-project activity that combines the learning acquired during the *Great Adventures* unit 1. *Boat Trip* 2. *Arctic Ride* 3. *Cave Car* 4. *Animal Alarm* 5. *Underwater Quest* 6. *Treehouse Camp*	Open-project activity that combines the knowledge/ skills acquired during the Great Adventures unit.	Open-project activity that combines the building/ programming skills acquired during the Great Adventures unit. See instructions or samples in the unit lessons for support.

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		Design Engineering—Grade 2 (Back to the top of DESIGN ENGINEERING)			
A. **Topic**	**B.** **Target Educational Standards (e.g., NGSS, CSTA)**	**C.** **LEGO® Education Unit,** *Lesson Title* **(Target Grade, Level of Difficulty in the Unit)**	**D.** **Activity of Lesson**	**E.** **Assumed Skills and Knowledge**	**F.** • **LEGO® Elements** • **Tools and Materials**
Design Engineering	**NGSS** K-2-ETS1–1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	Amazing Amusement Park Lesson 1: *The Fast Lane* (Grade 2: Beginner)	• Ask questions and make observations for how to avoid standing in a long line. • Develop and improve the solution to solve the defined problem.	• Ask questions about a defined problem. • People can develop/create tools to solve problems. • The function of light matrixes and color sensors	• LEGO® Education SPIKE™ Essential light matrix and color sensor • SPIKE™ Essential Programming blocks: 3×3 Light, Loop, Wait for, Sound, Random and Bar Graph Blocks
		Amazing Amusement Park Lesson 2: *Classic Carousel* (Grade 2: Intermediate) Also see *FIRST* LEGO League Explore—*Explore Lesson 1* (Grades 1–5: Beginner)	• Ask questions and make observations for how to make a carousel spin differently. • Improve the solution by modifying the prototypes.	• Ask questions about a defined problem. • Design process: iterating prototypes • Common rides in an amusement park	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Wait for, Display, Loop and Sound Blocks
		Amazing Amusement Park Lesson 5: *Twirling Teacups* (Grade 2: Intermediate)	• Ask questions and make observations to investigate how new seats on a spinning ride will move. • Improve the solution by modifying the prototypes.	• Ask questions about a defined problem. • Design process: iterating prototypes • Common rides in an amusement park	• SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Motor, Event, Loop and Sound Blocks
Design Engineering	**NGSS** K-2-ETS1–2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	Amazing Amusement Park Lesson 3: *The Perfect Swing* (Grade 2: Intermediate)	• Design to make a model swing move differently, so that it doesn't go fast and fits two people. • Predict the motion of the swing when making design changes.	• Design process, including sketching, and iteration • Using physical materials to design a solution. • Common rides in an amusement park	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Loop and Sound Blocks

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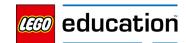| A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Design Engineering	**NGSS** K-2-ETS1–3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	Amazing Amusement Park Lesson 4: *Snack Stand* (Grade 2: Intermediate)	Build model snack bars and use them to compare the different solutions and explain each one's strengths and weaknesses.	• Read graphical displays (tables, pictographs, line plots). • Compare and contrast. • Test and observe design solutions. • Common rides in an amusement park	• LEGO® Education SPIKE™ Essential Motor and color sensor • SPIKE™ Essential Programming blocks: Motor, Wait for and Sound Blocks.
		Amazing Amusement Park Lesson 6: *The Spinning Ferris Wheel* (Grade 2: Intermediate)	• Program to change the Ferris wheel's motion so it stops to let riders get on. • Compare the different solutions for making the Ferris wheel better and be able to explain their strengths and weaknesses.	• Read graphical displays (tables, pictographs, line plots). • Test and observe design solutions. • Common rides in an amusement park • The function of light matrixes	• SPIKE™ Essential light matrix • SPIKE™ Essential Programming blocks: Motor, Event, 3×3 Light, Loop, Wait for, Sound and Random Blocks
Design Engineering	**NGSS** K-2-ETS1–1 **NGSS** K-2-ETS1–2 **NGSS** K-2-ETS1–3	Amazing Amusement Park Lesson 7: *The Most Amazing Amusement Park* (Grade 2: Advanced) **OPEN PROJECT**	• Build a model to add a new ride to the amusement park. • Open-project activity that combines the learning acquired during the *Amazing Amusement Park* unit. 1. *Fast Lane* 2. *Classic Carousel* 3. *The Perfect Swing* 4. *Snack Stand* 5. *Twirling Teacups* 6. *The Spinning Ferris Wheel*	• Open-project activity that combines the knowledge/ skills acquired during the Amazing Amusement Park unit.	• Open-project activity that combines the building/ programming skills acquired during the Amazing Amusement Park unit. See instructions or samples in the unit lessons for support.
Design Engineering	Open format, hybrid Learning with LEGO® Education Personal Learning Kit Essential; no standards	Amazing Amusement Park Lesson 8: *Remix the Ride* (Grade 2: Beginner)	Design a ride for Sofie	• Design process, including sketches, and iteration	LEGO Education Personal Learning Kit Essential

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Design Engineering—Grade 3 (Back to the top of DESIGN ENGINEERING)					
A. Topic	**B.** Target Educational Standards (e.g., NGSS, CSTA)	**C.** LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	**D.** Activity of Lesson	**E.** Assumed Skills and Knowledge	**F.** • LEGO® Elements • Tools and Materials
Design Engineering	**NGSS** 3–5-ETS1–1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	Happy Traveler Unit Lesson 1: *River Ferry* (Grade 3: Beginner)	• Design and build a ferry model that moves. • Modify it based on a defined design problem to help Daniel have a fun ferry ride.	• Design process: sketching and iterating • Design criteria and constraints	• LEGO® Education SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Display and Sound Blocks
	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.	Happy Traveler Unit Lesson 2: *Taxi! Taxi!* (Grade 3: Intermediate)	Design a taxi model that meets the necessary criteria and constraints, including moving to follow different routes.	• Design process: sketching and iterating. • Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions	• SPIKE™ Essential motor (x2) • SPIKE™ Essential Programming blocks: Movement and Wait for Blocks
		Happy Traveler Lesson 5: *Cable Car* (Grade 3: Intermediate)	• Design a cable car model that meets the necessary criteria and constraints, including repeated motion from one side to the other side. • Predict motion to support design success.	• Design process: sketching and iterating • Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Wait for, Display and Sound Blocks
		Happy Traveler Lesson 6: *Big Bus* (Grade 3: Intermediate)	Design a bus model that meets the necessary criteria and constraints, including stopping at different stops.	• Design process: sketching and iterating. • Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions • The function of color sensors	• SPIKE™ Essential motor and color sensor • SPIKE™ Essential Programming blocks: Motor, Event, Wait for, Display, Sensor, and Sound Blocks

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, Lesson Title	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Design Engineering	NGSS 3–5-ETS1–3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Happy Traveler Lesson 3: _Hovering Helicopter_ (Grade 3: Intermediate)	Build and program a helicopter model, including moving differently when tilted.	• Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions • Collect and record data	• LEGO® Education SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Event, Display and Wait for Blocks
		Happy Traveler Lesson 4: _Swamp Boat_ (Grade 3: Intermediate)	Build a Swamp Boat to help Sofie find animals in the water. Upgrade the Swamp Boat to detect more animals.	• Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions • Collect and record data • The functions of light matrix and color sensors	• SPIKE™ Essential light matrix and color sensor • SPIKE™ Essential Programming blocks: Event, 3×3 Light, Loop, Sensor, and Sound Blocks
	NGSS 3–5-ETS1–1 NGSS 3–5-ETS1–2 NGSS 3–5-ETS1–3	Happy Traveler Lesson 7: _Get Around Town_ (Grade 3: Advanced) **OPEN PROJECT**	• Build a model to help Daniel, Leo, Sofie, and Maria reach the Spike castle. • Open-project activity that combines the learning acquired during the _Happy Traveler_ unit 1. _River Ferry_ 2. _Taxi! Taxi!_ 3. _Hovering Helicopter_ 4. _Swamp Boat_ 5. _Cable Car_ 6. _Big Bus_	Open-project activity that combines the knowledge/ skills acquired during the Happy Traveler unit.	Open-project activity that combines the building/ programming skills acquired during the Happy Traveler unit. See instructions or samples in the unit lessons for support.

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Design Engineering—Grade 4
(See adjacent grades for content to consider. Back to the top of DESIGN ENGINEERING)

Design Engineering—Grade 5
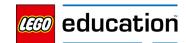(Back to the top of DESIGN ENGINEERING)

A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Design Engineering	**NGSS** 3–5-ETS1–1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	Quirky Creations Lesson 1: *Good Morning Machine* (Grade 5: Beginner)	Build a good morning machine model and modify it based on a defined design problem, so it waves in different ways.	• Design process: sketching and iterating. • Design criteria and constraints	• LEGO® Education SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Event, Loop, Wait For, Display and Sound Blocks
		Quirky Creations Lesson 4: *Trash Monster Machine* (Grade 5: Intermediate)	Build a model machine to collect and count trash of different colors.	• Design process: sketching and iterating • Design criteria and constraints	• SPIKE™ Essential motor and color sensor. • SPIKE™ Essential Programming blocks: Motor, Event, Loop, Wait For, Display, Bar Graph, and Sound Blocks
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.	Quirky Creations Lesson 2: *High-Tech Playground* (Grade 5: Intermediate)	Design and build a seesaw model that meets the necessary criteria and constraints, including making it more fun for Maria.	• Design process: sketching and iterating. • Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions • The function of the light matrix and Gyro Sensor	• SPIKE™ Essential motor, light matrix and Gyro Sensor • SPIKE™ Essential Programming blocks: Motor, Event, 3×3 Light, Loop, Wait For and Sound Blocks
		Quirky Creations Lesson 3: *Big Little Helper* (Grade 5: Intermediate)	Design a robot helper model that meets the necessary criteria and constraints, including helping Daniel get all his belongings home.	• Design process: sketching and iterating. • Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions	• SPIKE™ Essential motor(x2) • SPIKE™ Essential Programming blocks: Movement, Event, Loop, Wait For, and Sound Blocks
		Quirky Creations Lesson 6: *Literary Randomizer* (Grade 5: Intermediate)	Design a literary randomizer model that meets the necessary criteria and constraints, including helping Daniel pick a more exciting book.	• Design process: sketching and iterating. • Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions • The function of the light matrix	• SPIKE™ Essential light matrix • SPIKE™ Essential Programming blocks: 3×3 Light, Display, Loop, Wait For, Random, and Sound Blocks

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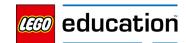
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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Design Engineering	**NGSS** 3–5-ETS1–3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Quirky Creations Lesson 5: *Winning Goal* (Grade 5: Intermediate)	• Design and build a model like a computer game • Upgrade the game to make it more fun, including by predicting motion from possible changes.	• Design criteria and constraints • Compare the strengths and weaknesses of multiple design solutions. • Collect and record data.	• LEGO® Education SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Event, Display, Loop, Wait For, Random and Sound Blocks
	NGSS 3–5-ETS1–1 **NGSS** 3–5-ETS1–2 **NGSS** 3–5-ETS1–3	Quirky Creations Lesson 7: *Your School Creation* (Grade 5: Advanced) **OPEN PROJECT**	• Build a model to use in the classroom where Daniel, Leo, Sofie, and Maria learn. • Open-project activity that combines the learning acquired during the *Quirky Creations* unit 1. *Good Morning Machine* 2. *Big Little Helper* 3. *High-Tech Playground* 4. *Trash Monster Machine* 5. *Winning Goal* 6. *Literary Randomizer*	Open-project activity that combines the knowledge/ skills acquired during the Quirky Creations unit.	Open-project activity that combines the building/ programming skills acquired during the Quirky Creations unit. See instructions or samples in the unit lessons for support.
Design Engineering	Open format, hybrid Learning with LEGO® Education Personal Learning Kit Essential; no standards	Quirky Creations Lesson 8: *Loads of Laundry* (Grade 5: Beginner)	Design a tool to help Leo pick up his laundry	Design process, including sketches, and iteration	LEGO Education Personal Learning Kit Essential

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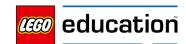| **Subject: Computer Science** Grade 1 Grade 2 Grade 3 Grade 4 Grade 5					
A. Topic	**B.** Target Educational Standards (e.g., NGSS, CSTA)	**C.** LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	**D.** Activity of Lesson	**E.** Assumed Skills and Knowledge	**F.** • LEGO® Elements • Tools and Materials
Computer Science—Grade 1 (Back to the top of COMPUTER SCIENCE)					
Algorithmic Thinking	**CSTA** K–2 1A-AP-08 Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks.	Great Adventures Lesson 1: *Boat Trip* (Grade 1: Beginner)	• Create different program sequences with actions that control the motors to push the boat in the water	• Events can happen in order/ sequence or follow a specified procedure.	• LEGO® Education SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor and sound Blocks.
	CSTA K–2 1A-AP-12 Develop plans that describe a program's sequence of events, goals, and expected outcomes.	Great Adventures Lesson 3: *Cave Car* (Grade 1: Intermediate)	Create different program sequences with actions that control the cave car's light	Events can happen in order/sequence or follow a specified procedure.	• SPIKE™ Essential light matrix • SPIKE™ Essential programming blocks: 3×3 Light, Loop, Wait for and Display Blocks. • A darkened space
Sequencing, Loops	**CSTA** K–2 1A-AP-10 Develop programs with sequences and simple loops, to express ideas or address a problem.	Great Adventures Lesson 4: *Animal Alarm* (Grade 1: Intermediate) Also see *FIRST* LEGO League Explore—*Explore Lesson 2* (Grades 1–5: Beginner)	• Create a program sequence for an animal alarm using an Event Block to control when the alarm goes off. • Identify patterns and actions in the existing program that can be reused to improve it, including using another Event Block to control actions for a different color.	• Events can happen in parallel/ loops/sequence of processes • The function of light matrixes and color sensors	• SPIKE™ Essential light matrix, color sensor; • SPIKE™ Essential Programming blocks: Sound and Light Blocks
		Great Adventures Lesson 5: *Underwater Quest* (Grade 1: Intermediate)	• Create a program sequence to move the submarine using Motor Blocks and a loop. • Identify patterns and actions in the existing program that can be reused to change the program sequence based on modifications to the model.	Events can happen in parallel/loops/ sequence of processes.	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Control Block – repeat loop; forever loop.

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Decomposition	**CSTA** K–2 1A-AP-11 Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.	Great Adventures Lesson 2: *Arctic Ride* (Grade 1: Intermediate) Also see *FIRST* LEGO League Explore—*Explore Lesson 3* (Grades 1–5: Beginner)	• Break down the problem of creating a program into smaller parts to understand which Movement Blocks to use. • Create the program sequence for Leo's round trip journey using different Movement Blocks to control the snowmobile.	Events can happen in parallel/loops/ sequence of processes.	• LEGO® Education SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Movement and Display Blocks
Debugging	**CSTA** K–2 1A-AP-14 Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.	Great Adventures Lesson 6: *Treehouse Camp* (Grade 1: Intermediate)	• Create a program sequence to open the treehouse roof using Motor Blocks. • Develop a solution to fix the program. • Change the program based on modifications to the model.	• Events can happen in parallel/ loops/sequence of processes. • An event sequence can be reorganized to meet changing needs.	• SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Motor, Event and Display Blocks
All listed topics	**CSTA** K–2 1A-AP-08 **CSTA** K–2 1A-AP-10 **CSTA** K–2 1A-AP-11 **CSTA** K–2 1A-AP-12 **CSTA** K–2 1A-AP-14	Great Adventures Lesson 7: *The Great Desert Adventure* (Grade 1: Beginner) **OPEN PROJECT**	• Build a model to help Daniel, Leo, Sofie, and Maria reach the pyramids. • Open-project activity that combines the learning acquired during the *Great Adventures* unit 1. *Boat Trip* 2. *Arctic Ride* 3. *Cave Car* 4. *Animal Alarm* 5. *Underwater Quest* 6. *Treehouse Camp*	Open-project activity that combines the knowledge/ skills acquired during the Great Adventures unit.	• Open-project activity that combines the building/ programming skills acquired during the Great Adventures unit. See instructions or samples in the unit lessons for support. • SPIKE™ Essential set

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Computer Science—Grade 2 (Back to the top of COMPUTER SCIENCE)					
A. Topic	**B. Target Educational Standards (e.g., NGSS, CSTA)**	**C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)**	**D. Activity of Lesson**	**E. Assumed Skills and Knowledge**	**F.** • **LEGO® Elements** • **Tools and Materials**
Algorithmic Thinking	**CSTA** K–2 1A-AP-08 Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks.	Amazing Amusement Park Lesson 5: *Twirling Teacups* (Grade 2: Intermediate)	• Create a program sequence for the teacups using a Motor Block for movement and Event Blocks to run parallel actions. • Identify patterns and actions in the existing program that can be reused to improve the program	Events can happen in order/sequence or follow a specified procedure.	• LEGO® Education SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Motor, Event, Loop, and Sound Blocks
	CSTA K–2 1A-AP-12	Amazing Amusement Park Lesson 2: *Classic Carousel* (Grade 2: Intermediate) Also see *FIRST* LEGO League Explore—*Explore Lesson 1* (Grades 1–5: Beginner)	• Program with Motor Blocks to make the carousel spin. • Use patterns and actions from the existing program to refine and improve the program.	Events can happen in a particular order/sequence or follow a specified procedure.	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Wait for, Display, Loop and Sound Blocks.
Sequencing, Loops	**CSTA** K–2 1A-AP-10 Develop programs with sequences and simple loops, to express ideas or address a problem.	Amazing Amusement Park Lesson 1: *The Fast Lane* (Grade 2: Beginner)	• Create a program sequence that uses Event Blocks to turn on the Fast Lane's light when a yellow "ticket" is shown. • Identify patterns and actions in the existing program that can be reused to create more actions using a Loop Block to automate the Fast Lane, or a Bar Graph Block to count how many times the Fast Lane has been activated.	• Events can happen in order/ sequence or follow a specified procedure. • The functions of light matrixes and color sensors.	• SPIKE™ Essential light matrix and color sensor • SPIKE™ Essential Programming blocks: 3×3 Light, Loop, Wait for, Sound, Random and Bar Graph Blocks
		Amazing Amusement Park Lesson 3: *The Perfect Swing* (Grade 2: Intermediate)	• Create a program sequence that uses Motor Blocks to move the swing. • Identify patterns and actions in the existing program that can be reused in a loop to automate the swing and improve the program.	• Events can happen in parallel/ loops/sequence of processes. • An event sequence can be reorganized to meet changing needs.	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Loop, and Sound Blocks.

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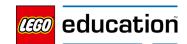| A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Decomposition	**CSTA** K–2 1A-AP-11 Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.	Amazing Amusement Park Lesson 4: *Snack Stand* (Grade 2: Intermediate)	• Create a program sequence that uses an Event Block to control when the snack stand will deliver a snack. • Identify patterns and actions in the existing program that can be reused to improve the program	Events can happen in parallel/loops/ sequence of processes	• LEGO® Education SPIKE™ Essential Motor and color sensor • SPIKE™ Essential Programming blocks: Motor, Wait for and Sound Blocks.
Debugging	**CSTA** K–2 1A-AP-14 Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.	Amazing Amusement Park Lesson 6: *The Spinning Ferris Wheel* (Grade 2: Intermediate)	• Program the Ferris wheel to move with a loop to control the rotations. • Identify patterns and actions in the existing program and use them to improve the program so the ride stops to let passengers get on and off.	Events can happen in parallel/loop/ sequence of processes. An event sequence can be reorganized to meet changing needs.	• SPIKE™ Essential light matrix • SPIKE™ Essential Programming blocks: Moter, Event, 3×3 Light, Loop, Wait for, Sound and Random Blocks
All listed topics	**CSTA** K–2 1A-AP-08 **CSTA** K–2 1A-AP-10 **CSTA** K–2 1A-AP-11 **CSTA** K–2 1A-AP-12 **CSTA** K–2 1A-AP-14	Amazing Amusement Park Lesson 7: *The Most Amazing Amusement Park* (Grade 2: Advanced) **OPEN PROJECT**	• Build a model to add a new ride to the amusement park. • Open-project activity that combines the learning acquired during the *Amazing Amusement Park* unit. 1. *Fast Lane* 2. *Classic Carousel* 3. *The Perfect Swing* 4. *Snack Stand* 5. *Twirling Teacups* 6. *The Spinning Ferris Wheel*	Open-project activity that combines the knowledge/ skills acquired during the Amazing Amusement Park unit.	Open-project activity that combines the building/ programming skills acquired during the Amazing Amusement Park unit. See instructions or samples in the unit lessons for support.

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Computer Science—Grade 3 (Back to the top of COMPUTER SCIENCE)					
A. Topic	**B. Target Educational Standards (e.g., NGSS, CSTA)**	**C. LEGO® Education Unit, _Lesson Title_ (Target Grade, Level of Difficulty in the Unit)**	**D. Activity of Lesson**	**E. Assumed Skills and Knowledge**	**F.** • LEGO® Elements • Tools and Materials
Sequencing, Loops, Conditionals	CSTA 3–5 1B-AP-10 Create programs that include sequences, events, loops, and conditionals.	Happy Traveler Lesson 5: _Cable Car_ (Grade 3: Intermediate)	• Create a program sequence that uses Motor Blocks to move the cable car and a loop to control it. • Generate a solution to fix errors in the cable car's movement.	• If...then (conditional consequences) • Sequences, events, and loops in programming	• LEGO® Education SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Wait for, Display and Sound Blocks
Decomposition	CSTA 3–5 1B-AP-11 Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process.	Happy Traveler Lesson 1: _River Ferry_ (Grade 3: Beginner)	• Break down Daniel's problem into smaller parts by discussing how to get from one place to another. • Create a program sequence for the ferry using Motor Blocks.	• Recognize and define computational problems. • Sequences, events, loops, and conditionals in programming	• SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Display and Sound Blocks
Algorithmic Thinking	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.	Happy Traveler Lesson 4: _Swamp Boat_ (Grade 3: Intermediate)	• Create a program sequence to identify crocodiles by turning on the swamp boat's light when "green" is detected. • Identify patterns and actions that can be used to modify the program by adding sounds, more lights, and bar graphs to count the crocodiles.	• Recognize and define computational problems. • Create computational artifacts. • Sequences, events, loops, and conditionals in programming • The function of light matrixes and color sensors	• SPIKE™ Essential light matrix and color sensor • SPIKE™ Essential Programming blocks: Event, 3×3 Light, Loop and Sound Blocks.
	CSTA 3–5 1B-AP-13 Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences.	Happy Traveler Lesson 6: _Big Bus_ (Grade 3: Intermediate)	Create a program sequence that uses Motor Blocks and the Color Sensor to make the bus stop at the green bus stop.	• Foster an inclusive computing culture • Create computational artifacts • The function of color sensors	• SPIKE™ Essential motor and color sensor • SPIKE™ Essential Programming blocks: Motor, Event, Wait for, Display, Sensor, and Wait for Blocks
Debugging	CSTA 3–5 1B-AP-15 Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.	Happy Traveler Lesson 2: _Taxi! Taxi!_ (Grade 3: Intermediate)	• Create and program a sequence that moves the taxi forward and uses Movement Blocks to make a turn. • Identify patterns and actions in the existing program that can be reused for next trip.	• Common coding blocks • Test and refine computational artifacts.	• SPIKE™ Essential motor (x2) • SPIKE™ Essential Programming blocks: Movement and Wait for Blocks

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Abstract Thinking	**CSTA** 3–5 1B-AP-17 Describe choices made during program development using code comments, presentations, and demonstrations.	Happy Traveler Lesson 3: *Hovering Helicopter* (Grade 3: Intermediate)	• Create a program sequence that uses Motor Blocks to move the helicopter's rotor blades. • Look for patterns and actions that can be applied to the Tilt Sensor when the helicopter is tilted. • Describe learning and choices when creating programs.	Communicate about computing (code comments, presentations, and demonstrations)	• LEGO® Education SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Event, Display, Sensor, and Wait for Blocks
All Topics Listed	**CSTA** 3–5 1B-AP-10 **CSTA** 3–5 1B-AP-11 **CSTA** 3–5 1B-AP-12 **CSTA** 3–5 1B-AP-13 **CSTA** 3–5 1B-AP-15 **CSTA** 3–5 1B-AP-17	Happy Traveler Lesson 7: *Get Around Town* (Grade 3: Advanced) **OPEN PROJECT**	• Build a model to help Daniel, Leo, Sofie, and Maria reach the Spike castle. • Open-project activity that combines the learning acquired during the *Happy Traveler* unit. 1. *River Ferry* 2. *Taxi! Taxi!* 3. *Hovering Helicopter* 4. *Swamp Boat* 5. *Cable Car* 6. *Big Bus*	Open-project activity that combines the knowledge/ skills acquired during the Happy Traveler unit.	Open-project activity that combines the building/ programming skills acquired during the Happy Traveler unit. See instructions or samples in the unit lessons for support.

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Computer Science—Grade 4					
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A. Topic	**B.** Target Educational Standards (e.g., NGSS, CSTA)	**C.** LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	**D.** Activity of Lesson	**E.** Assumed Skills and Knowledge	**F.** • LEGO® Elements • Tools and Materials
Algorithmic Thinking **Abstract Thinking**	**CSTA** 3–5 1B-DA-07 Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.	Crazy Carnival Games Lesson 1: *Mini Mini-Golf* (Grade 4: Beginner)	• Create a program sequence to get a hole-in-one, using Motor Blocks to control hitting the golf ball. • Describe learning about speed and energy	• Organize and present collected data visually. • Communicate about computing • The function of light matrixes	• LEGO® Education SPIKE™ Essential motor and light matrix • SPIKE™ Essential Programming blocks: Motor, 3×3 Light and Sound Blocks
		Crazy Carnival Games Lesson 4: *A-Maze-ing* (Grade 4: Intermediate)	• Create a program sequence for the maze game using Motor Blocks and a sensor to control the sound. • Describe ways interactions between two objects can impact an object's energy.	• Organize and present collected data visually. • Communicate about computing. • Function of Gyro Sensors	• SPIKE™ Essential light matrix, Gyro Sensor • SPIKE™ Essential Programming blocks: Event, 3×3 Light, Bar Graph and Sound Blocks
	CSTA 3–5 1B-AP-08 Compare and refine multiple algorithms for the same task and determine which is the most appropriate	Crazy Carnival Games Lesson 5: *Avoid the Edge* (Grade 4: Intermediate)	• Create a program sequence for the game using the Tilt Sensor to count the number of tilts. • Describe learning about energy conversion.	• Test and refine computational artifacts. • Recognize and define computational problems. • Function of color sensors	• SPIKE™ Essential motor and color sensor • SPIKE™ Essential Programming blocks: Motor, Sensor, Wait For, If Then/If Then Else and Sound Blocks
Sequencing, Loops, Conditionals	**CSTA** 3–5 1B-AP-10 Create programs that include sequences, events, loops, and conditionals.	Crazy Carnival Games Lesson 3: *High Stick Hockey* (Grade 4: Intermediate)	• Create a program sequence using Motor Blocks to run the hockey game. Identify patterns and actions to use in a program loop. • Describe how energy moves from place to place.	Sequences, events, loops, and conditionals in programming	• SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Loop, Wait For, Random and Sound Block

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Algorithmic Thinking	**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.	Crazy Carnival Games Lesson 2: *Bowling Fun* (Grade 4: Intermediate)	• Create a program sequence to get a strike in a bowling game, using Motor Blocks to control the ball's movement. • Describe the relationship between energy and force.	• Recognize and define computational problems. • Create computational artifacts. • Sequences, events, loops, and conditionals in programming	• LEGO® Education SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Wait For, Display, Random and Sound Blocks
		Crazy Carnival Games Lesson 6: *Junior Pinball* (Grade 4: Intermediate)	• Create a program sequence for the pinball machine using Motor Blocks to start the game. • Modify the program by identifying patterns and actions to use in a loop.	• Recognize and define computational problems. • Create computational artifacts. • Sequences, events, loops, and conditionals in programming	• SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Loop, Wait For, Sound, Display and Random Blocks.
All Topics Listed	**CSTA** 3–5 1B-DA-07 **CSTA** 3–5 1B-AP-08 **CSTA** 3–5 1B-AP-10 **CSTA** 3–5 1B-AP-12	Crazy Carnival Games Lesson 7: *Creative Carnival Games* (Grade 4: Advanced) **OPEN PROJECT**	• Build a model to add a new game to the carnival. • Open-project activity that combines the learning acquired during the *Crazy Carnival Games* unit. 1. *Mini Mini-Golf* 2. *Bowling Fun* 3. *High Stick Hockey* 4. *A-Maze-ing* 5. *Avoid the Edge* 6. *Junior Pinball*	Open-project activity that combines the knowledge/ skills acquired during the Crazy Carnival Games unit.	Open-project activity that combines the building/ programming skills acquired during the Crazy Carnival Games unit. See instructions or samples in the unit lessons for support.

Computer Science—Grade 5
(Back to the top of COMPUTER SCIENCE)

A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Algorithmic Thinking	**CSTA** 3–5 1B-AP-08 Compare and refine multiple algorithms for the same task and determine which is the most appropriate.	Quirky Creations Lesson 3: *Big Little Helper* (Grade 5: Intermediate)	• Create a program sequence that controls the robot helper using Movement Blocks. • Identify patterns and actions in the existing program that can be reused to enable the robot helper to follow Daniel home.	• Test and refine computational artifacts. • Recognize and define computational problems.	• SPIKE™ Essential motor (x2) • SPIKE™ Essential Programming blocks: Movement, Event, Loop, Wait For, and Sound Blocks

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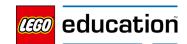| A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Sequencing, Loops, Conditionals	**CSTA** 3–5 1B-AP-10 Create programs that include sequences, events, loops, and conditionals.	Quirky Creations Lesson 6: *Literary Randomizer* (Grade 5: Intermediate)	• Create a program sequence that helps Daniel choose a book he will like. • Identify patterns and actions in the existing program that can be reused to improve the literary randomizer (book selector).	• Sequences, events, loops, and conditionals in programming • The function of light matrixes	• LEGO® Education SPIKE™ Essential light matrix • SPIKE™ Essential Programming blocks: 3×3 Light, Display, Loop, Wait For, Random and Sound Blocks
Decomposition	**CSTA** 3–5 1B-AP-11 Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process.	Quirky Creations Lesson 5: *Winning Goal* (Grade 5: Intermediate)	• Break down the problem by identifying why the program doesn't enable the model to save a goal. • Create a program sequence that uses Motor Blocks to move the goal, making it harder to score. • Identify patterns and actions in the existing program that can be reused to improve the program with a loop.	• Recognize and define computational problems. • Sequences, events, loops, and conditionals in programming	• SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Event, Display, Loop, Wait For, Random and Sound Blocks
Algorithmic Thinking	**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.	Quirky Creations Lesson 2: *High-Tech Playground* (Grade 5: Intermediate)	• Create a program sequence for the seesaw using Motor Blocks and the Tilt Sensor. • Identify patterns and actions in the existing program that can be reused to improve the seesaw.	• Recognize and define computational problems. • Create computational artifacts. • Sequences, events, loops, and conditionals in programming • The functions of light matrixes and Gyro Sensors	• SPIKE™ Essential motor, light matrix and Gyro Sensor • SPIKE™ Essential Programming blocks: Motor, Event, 3×3 Light, Loop, Wait For, and Sound Blocks
	CSTA 3–5 1B-AP-13 Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences.	Quirky Creations Lesson 4: *Trash Monster Machine* (Grade 5: Intermediate)	• Create a program sequence for the Trash Monster using Motor Blocks and the Color Sensor. • Identify patterns and actions in the existing program that can be reused to make the Trash Monster react to different-colored trash.	• Foster an inclusive computing culture • Create computational artifacts • The function of color sensors	• SPIKE™ Essential motor and color sensor. • SPIKE™ Essential Programming blocks: Motor, Event, Loop, Wait For, Display, Bar Graph, and Sound Blocks

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Abstract Thinking	**CSTA** 3–5 1B-AP-17 Describe choices made during program development using code comments, presentations, and demonstrations.	Quirky Creations Lesson 1: *Good Morning Machine* (Grade 5: Beginner)	• Break down Leo's problem into smaller parts to define and understand it. • Create a program sequence for the waving machine using Motor Blocks to move the hand. • Modify the program by identifying patterns and actions to use in a loop.	Communicate about computing (code comments, presentations, and demonstrations)	• LEGO® Education SPIKE™ Essential motor • SPIKE™ Essential Programming blocks: Motor, Event, Loop, Wait For, Display and Sound Blocks
All Listed Topics	**CSTA** 3–5 1B-AP-08 **CSTA** 3–5 1B-AP-10 **CSTA** 3–5 1B-AP-11 **CSTA** 3–5 1B-AP-12 **CSTA** 3–5 1B-AP-13 **CSTA** 3–5 1B-AP-17	Quirky Creations Lesson 7: *Your School Creation* (Grade 5: Advanced) **OPEN PROJECT**	• Build a model to use in the classroom where Daniel, Leo, Sofie, and Maria learn. • Open-project activity that combines the learning acquired during the *Quirky Creations* unit 1. *Good Morning Machine* 2. *Big Little Helper* 3. *High-Tech Playground* 4. *Trash Monster Machine* 5. *Winning Goal* 6. *Literary Randomizer*	Open-project activity that combines the knowledge/ skills acquired during the Quirky Creations unit.	Open-project activity that combines the building/ programming skills acquired during the Quirky Creations unit. See instructions or samples in the unit lessons for support.

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title* (Target Grade, Level of Difficulty in the Unit)	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
FLL—All Grades					
Design Engineering **Algorithmic Thinking** **Forces and Motion**	**NGSS** K-2-ETS1–1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. **CSTA** K–2 1A-AP-12 Develop plans that describe a program's sequence of events, goals, and expected outcomes.	*FIRST* LEGO League Explore *Explore Lesson 1* (Grades 1–5: Beginner) Based on *Classic Carousel*	• Ask questions and make observations for how to make a carousel spin differently. • Improve the solution by modifying the prototypes. • Program with Motor Blocks to make the carousel spin. • Use patterns and actions from the existing program to refine and improve the program.	• Ask questions about a defined problem. • Design process: iterating prototypes • Common rides in an amusement park • Events can happen in a particular order/sequence or follow a specified procedure.	• LEGO® Education SPIKE™ Essential Motor • SPIKE™ Essential Programming blocks: Motor, Wait for, Display, Loop, and Sound Blocks. • *FIRST* LEGO League Explore Set and Engineering Notebook
Design Engineering **Waves: Light**	**NGSS** 1-PS4–4 Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. **CSTA** K–2 1A-AP-10 Develop programs with sequences and simple loops, to express ideas or address a problem.	*FIRST* LEGO League Explore *Explore Lesson 2* (Grades 1–5: Beginner) Based on *Animal Alarm*	• Design a device that uses light or sound to communicate across distance as an alarm when animals come at night. • Create a program sequence for an animal alarm using an Event Block to control when the alarm goes off. • Identify patterns and actions in the existing program to refine and improve the program.	• Design process, including sketches and iteration • Designing devices that create sound • Light and sound can travel over a distance • The function of the color sensor • Understand that events can happen in parallel/loops/ sequence processing • The function of light matrixes and color sensors.	• SPIKE™ Essential light matrix, color sensor; • SPIKE™ Essential Programming blocks: Sound and Light Blocks. • *FIRST* LEGO League Explore Set and Engineering Notebook

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A. Topic	B. Target Educational Standards (e.g., NGSS, CSTA)	C. LEGO® Education Unit, *Lesson Title*	D. Activity of Lesson	E. Assumed Skills and Knowledge	F. • LEGO® Elements • Tools and Materials
Weather and Climate **Engineering Design**	**NGSS** K-2-ETS1–2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. **CSTA** K–2 1A-AP-11 Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.	*FIRST* LEGO League Explore *Explore Lesson 3* (Grades 1–5: Beginner) Based on *Arctic Ride*	• Design and build a snowmobile model to illustrate how the shape of an object helps it function as needed to solve a given problem (moving on the ice). • Break down the programming problem into smaller parts to choose which Movement Blocks to use. • Create the program sequence for Leo's round trip journey using different Movement Blocks to control the snowmobile.	• Basic directions (left, right, forward, and backward) • Arctic habitat • Design process, including sketches, and iteration • Using physical materials to design a solution • Events can happen in parallel/ loops/sequence of processes.	• LEGO® Education SPIKE™ Essential Motor (x2) • SPIKE™ Essential Programming blocks: Movement and Display Blocks • *FIRST* LEGO League Explore Set and Engineering Notebook

Plan a LEGO® Education Lesson

Lesson Planning Protocol

Use the directions below to plan lessons that meet your students' needs. See Ways to Use the Guide for additional guidance.

When	Who	Why
During lesson planning	Teachers and coaches	To plan the details of a LEGO® Education lesson, including how to differentiate, what to observe during instruction, and logistical details for all learners
How	Complete the Lesson Planning Protocol, using the referenced columns of the Integrating Topics and Lessons Charts and these steps: 1. Choose a lesson at legoeducation.com/lessons. Match it and the standard to other curriculum content (columns A–C of the protocol + topic integration notes or guidance you or planners have created). 2. Plan the sequence of instruction (columns C–E). 3. Analyze the standard to determine the criteria for success in each stage of the lesson (column B + the lesson). 4. Plan any necessary differentiation and scaffolding for students (columns C–F). 5. Plan logistics, including materials, room arrangement, and groupings (column F). 6. Reflect on the lesson after instruction. 7. Write your notes in a chart like the one below or your own planning documents. Use the completed Example in this guide to support your work.	

1. Match the lesson to other curriculum content. (See relevant Integrating Topics and Lessons Chart, columns A–C)		
TOPIC & STANDARD What topic & standard do I wish to supplement with a hands-on lesson? (See columns A–B.)	LESSON Which lesson from our topic integration aligns with this topic and standard? (See columns B–C.)	CURRICULUM SEQUENCE & RATIONALE What unit and curriculum will the lesson align to? When in the unit does this lesson fit? (Consider both content and difficulty.) What purpose does it serve?

2. Plan the sequence of instruction. (See relevant Integrating Topics and Lessons Chart, columns C–E)

GRADE LEVEL OR DIFFICULTY ADJUSTMENTS	ASSUMED KNOWLEDGE & SKILLS	PRE-TEACHING PLAN
For what grade level is the lesson targeted? (See column C.)	(See columns D–E, plus any integration notes created.) What will students need to know or be able to do prior to the lesson?	What will I need to teach prior to this lesson? When and how will I incorporate the pre-teaching?
How will I modify it for the grade level I teach?		
If Designed for a Lower Grade Decide how to add a challenge: • Reduce explanations during Engage portion. • Let students take the lead during Explore and Explain. • Add or increase task complexity in Elaborate.	Terms to understand (from standard): What from this list may need review before the LEGO® Education lesson?	How will I pre-teach or reinforce vocabulary?
If Designed for a Higher Grade Decide how to simplify: • Add explanations, modeling, and/or definitions during Engage. • Extend time for Explore. • Alter the task.		
Where does the lesson fit in the unit progression from Beginner to Advanced? (See column C)	What lesson from my core curriculum can I leverage to teach this material?	What framing will I add to Engage to reinforce these skills & knowledge?
Decide if or how to scaffold, such as by: • Completing an Intermediate lesson first. • Preteaching difficult building and programming in other ways.		

3. Analyze the standard to determine the criteria for success throughout the lesson. (See relevant Integrating Topics and Lessons Chart, column B + the lesson)

STANDARD ANALYSIS
Key Standard(s):
What terms and concepts does the standard target for student understanding?
(These are usually the nouns of the standard.) If appropriate, add these to the list of prerequisite knowledge above.

What skills and actions does the standard require students to demonstrate?
(These are usually the verbs of the standard.) If appropriate, add these to the list of prerequisite skills above.

LEARNING CRITERIA
Read each section of the lesson and consider:
What criteria will determine meaningful progress with the standard?
What should I see and hear from students related to the knowledge and skills of the standard?
What will students record or demonstrate?

Engage:

Explore:

Explain:

Elaborate:

Evaluate:

4. Plan any necessary differentiation and scaffolding for your students. (See relevant Integrating Topics and Lessons Chart, columns D–E)

DIFFERENTIATION & SCAFFOLDING
What possible obstacles or undeveloped thinking ("misconceptions") might students encounter in any part of the lesson?
Unless these impede lesson progress, support students in solving problems or issues that arise and/or reflect on them during Explain.
"Misconceptions" and errors are an intrinsic part of discovery-based learning and often reflect students' appropriate cognitive development.

Possible Obstacles	Questions & Strategies to Support Problem-Solving

How will I reinforce and scaffold new skills and knowledge during the lesson? (These are identified in section 2. Plan the sequence of Instruction, Prerequisites, above)

What other strategies will I implement for students who need additional or different support to access the lesson? (See the Supporting All Learners section.)

Strategic partnering   Individual cue cards or direction sheets

Pictures added to directions   Assign a help buddy

Teacher modeling   Additional time

Voice to text software   Alternative delivery methods, e.g., video Explain

Other:

5. Plan the logistics of the lesson. (See relevant Integrating Topics and Lessons Chart, column F)

MATERIALS & SPACE CONSIDERATIONS
What materials need to be gathered? What will I prepare beforehand?

What, if any, special room arrangements does the lesson require?

How will students access materials during the lesson? (i.e., assigned students will distribute; each table will have a set of needed materials; other)

GROUPING
How will I organize students for learning? Who will each student partner with?

6. Reflect on the lesson after instruction.

REFLECTIONS
What went well? What could have gone better? Any surprises? What would I change next time? What should I review, repeat, adapt, or reteach to support any continued gaps in students' understanding of the concepts/skills in the lesson?

Lesson Planning Protocol Exemplar

SPIKE Essential Science Grade 2, Unit 2: Science in Nature and Our Daily Life, Lesson 3: Pollination

1. Match the lesson to other curriculum content. (See relevant Integrating Topics and Lessons Chart, columns A–C)		
TOPIC & STANDARD What topic & standard do I wish to supplement with a hands-on lesson? (See columns A–B.) *Pollination* *Standard NGSS 2-LS2–2: Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*	LESSON Which lesson from our topic integration aligns with this topic and standard? (See columns B–C.) *Pollination*	CURRICULUM SEQUENCE & RATIONALE What unit and curriculum will the lesson align to? When in the unit does this lesson fit? (Consider both content and difficulty.) What purpose does it serve? *Integrates with our science unit Plants & Animals. Goes well after lessons on plant parts and our own planting experiments because then students will understand what flowering plants need to make new plants and how animals help the pollination process. What parts of plants and animals make pollen transfer possible?* *The interactive aspect of this lesson will help students learn and visualize the process of pollination (and seed dissemination if they complete Elaborate).*

2. Plan the sequence of instruction. (See relevant Integrating Topics and Lessons Chart, columns C–E)

GRADE-LEVEL OR DIFFICULTY ADJUSTMENTS	ASSUMED KNOWLEDGE & SKILLS	PRE-TEACHING PLAN

GRADE-LEVEL OR DIFFICULTY ADJUSTMENTS

For what grade level is the lesson targeted? (See column C.)
Grade 2

How will I modify it for the grade level I teach?

<u>If Designed for a Lower Grade</u>
Decide how to add a challenge, such as by:
- Reducing explanations during Engage
- Letting students take the lead during Explore and Explain
- Adding or increasing task complexity in Elaborate

Adding peer review

<u>If Designed for a Higher Grade</u>
Decide how to simplify, such as by:
- Adding explanations, modeling, and/or definitions during Engage
- Extending time for Explore
- Altering the task.

No alterations needed—it's a grade 2 lesson & I'm using it for second graders.

Where does the lesson fit in the unit progression from Beginner to Advanced? (See column C)
Lesson 3: Intermediate

Decide if or how to scaffold, such as by:
- Completing an Intermediate lesson first.
- Preteaching difficult building and programming in other ways.

Use the Tutorial Activities to preteach difficult programming.

ASSUMED KNOWLEDGE & SKILLS

What will students need to know or be able to do prior to the lesson? (See columns D–E plus lesson integration notes.)

- *Flowering plants produce seeds.*
- *Seeds grow into new plants.*
- *Flowering plants need pollen from other plants for seeds to develop.*
- *Animals help spread pollen through direct contact with certain parts of plants.*
- *Models can mimic, or show, processes from nature.*

Terms to understand (from standard and lesson):
mimic, function, pollen, pollination, disperse (in Elaborate)

What from this list may need review before the LEGO® Education lesson?

- *Concept: Plants produce seeds and pollen.*
- *Concept: Animals help pollination through direct contact with plants.*
- *Vocabulary: pollen, pollination, disperse, mimic, function*

What lesson from my core curriculum can I leverage to teach this material?

Plant Parts: Have students draw and label a plant's parts. Add some questions and discussion about pollen.

PRE-TEACHING PLAN

What will I need to teach prior to this lesson?
When and how will I incorporate the pre-teaching?

After Plant Parts lesson:
- *Add time for discussion and questions about the plant drawings; confirm students understand that many plants make seeds. Some questions to ask: What is this part? What is pollen? Where does the pollen come from? Where does it go? How do you think that happens? What part of an animal could touch this part of a plant to get pollen? How does the pollen get to a different plant?*
- *Read and discuss Seeds Move by Robin Page for Interactive Readaloud the day before.*

How will I pre-teach or reinforce vocabulary?

Using the definitions in my core science materials. Examples:
- *Pollen/pollination: Have students label in their diagram of plant parts. Explain that pollination describes the process of moving pollen from a male part of one plant to a female part of another.*
- *Disperse: Use the word disperse at snack time—"Pretend you are bees. The snack helpers at your table will disperse a snack to you."*

During partner talk about plants, ask and/or remind students, "What important words should I hear?" and include pollen/pollination in list.

What framing will I add to Engage to reinforce these skills & knowledge?
- *Show plants such as lilies (with obvious stamens, anthers, stigma, pollen) for students to examine. Will ask: Where is the pollen in each plant? How might that pollen get to another plant? In Elaborate, share about plants like burdock (which have burrs encasing the seeds) and currants (which have soft fruit around the seeds) to discuss how animals participate in seed dispersal.*
- *Ask students to read the lesson anchor chart and explain the task of working with partners to create a model to show pollination.*
- *Review that students will use the model they build to explain how pollination (or seed dispersal in Elaborate) happens in nature.*

3. Analyze the standard to determine the criteria for success throughout the lesson. (See relevant Integrating Topics and Lessons Chart, column B + the lesson)

STANDARD ANALYSIS
Key Standard(s):
What terms and concepts does the standard target for student understanding?
(These are usually the nouns of the standard.) If appropriate, add these to the list of prerequisite knowledge above.
Mimic, pollination, pollen, seed, dispersal, model, function

What skills and actions does the standard require students to demonstrate?
(These are usually the verbs of the standard.) If appropriate, add these to the list of prerequisite skills above.
Making a model to mimic, or show, how something works, explaining the process of pollination

LEARNING CRITERIA
Read each section of the lesson and consider:
What criteria will determine meaningful progress with the standard?
What should I see and hear from students related to the knowledge and skills of the standard?
What will students record or demonstrate?

Engage:
Hear—Students talking about pollination and seeds as they handle plants or talking about how pollen can get on a bee, bird, or butterfly

Explore:
See—Students building, making plant and animal parts that touch to transfer pollen; Hear—Students discussing their plan with language such as seeds, pollen, spreading, touching

Explain:
See/Hear—Each student accurately explains the process of pollination that their model represents or answers questions about it. The explanation shows that there is direct contact between parts of the plant and parts of the animal in order to transfer pollen.

Elaborate:
Hear—Each student explains what they learned by building their model. Each student reflects on the building process and answers the question Did building the model change how you think about pollination?

Evaluate:
Hear—Student explanations are the most important criteria for success, rather than the details of their model.
See/Hear—Students peer-evaluate for both aspects (explanation and model showing the pollination process).

4. Plan any necessary differentiation and scaffolding for your students. (See relevant Integrating Topics and Lessons Chart, columns D–E)

DIFFERENTIATION & SCAFFOLDING
What possible obstacles or undeveloped thinking ("misconceptions") might students encounter in any part of the lesson?
Unless these impede lesson progress, support students in solving problems or issues that arise and/or reflect on them during Explain.
"Misconceptions" and errors are an intrinsic part of discovery-based learning and often reflect students' appropriate cognitive development.

Students may forget some terms and speak generally. Students may be challenged by building models.

Possible Obstacles	Questions & Strategies to Support Problem-Solving
Forgetting terms	*"Is there a term on our anchor chart that can help you?"*
Difficulty building a model	*Will partner students strategically. May invite to walk around mid-lesson and see how others approach the problem to help generate their own ideas.*

How will I reinforce and scaffold new skills and knowledge during the lesson? (identified in 2. Plan the sequence of Instruction, Prerequisites, above)
Refer to and use outputs from the three lessons before this on plant parts and seeds.
Create an anchor chart with vocabulary terms (pollination, pollen, seed, disperse) and pictures.

What other strategies will I implement for students who need additional or different support to access the lesson? (See the Supporting All Learners section.)

- ✓ Strategic partnering
- ✓ Pictures added to directions
- ☐ Teacher modeling
- ☐ Voice to text software
- ☐ Individual cue cards or direction sheets
- ☐ Assign a help buddy
- ☐ Additional time
- ☐ Alternative delivery methods, e.g., video Explain
- ✓ Other: *Plan to add second lesson session to finish building and to complete the Explain and Elaborate self-reflection.*

5. Plan the logistics of the lesson. (See relevant Integrating Topics and Lessons Chart, column F)

MATERIALS & SPACE CONSIDERATIONS
What materials need to be gathered? What will I prepare beforehand?

LEGO® Education SPIKE™ Essential sets and devices with LEGO® Education SPIKE™ App
Will prepare the anchor chart with pictures beforehand

What, if any, special room arrangements does the lesson require?

Two pairs will work at each table.

How will students access materials during the lesson? (Assigned students will distribute; each table will have a set of needed materials; other):

Each table pair will have a SPIKE Essential set and device to share; other materials can be shared by the whole table.

GROUPING
How will I organize students for learning? Who will each student partner with?
Partner to support equitable sharing during work (avoiding teams where one partner might dominate)

Axel-Andrew	*Fenja-Grace*	*Paloma-Peter*
Bette-Branson	*Max-Michael*	*Quinn-Saul*
David-Erik	*Nicco-Otto*	*Scarlett-Terry-Will*

6. Reflect on the lesson after instruction.

REFLECTIONS
What went well? What could have gone better? Any surprises? What would I change next time? What should I review, repeat, adapt, or reteach to support any continued gaps in students' understanding of the concepts/skills in the lesson?

Lesson went well. Students enjoyed it and are fluent in most concepts now. Engage took longer (15 minutes), but the extra time was worth it for cementing concepts and inciting engagement. Needed second lesson to finish building. Peer review would benefit from a brief model of what/how to say beforehand. Students need some reinforcement to clarify that direct contact is needed between plants and animals for pollen transfer and that the plants and animals have special parts that make this transfer work.