5. Avoid the Edge
LEGO Spike Essential - Crazy Carnival Games

Subject: STEAM, Science	**Topic or Unit of Study:** Energy, Energy Transfer
Grade/Level: Grades 3-5	**Time Allotment:** 1.5 hours
Objectives: ● We will explore and describe energy conversion (potential and kinetic energy). ● We will apply and test existing scientific knowledge of energy conversion. ● We will engage effectively in a range of collaborative discussions.	Standards: **4-PS3-4:** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. **ISTE 1.3d:** Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions. **5.AP.A.01:** Develop, compare, and refine multiple algorithms for the same task and determine which algorithm is the most appropriate. **ELA-LITERACY.SL.4.1:** Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-lef) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.
Synopsis: This unit will develop your students' understanding of energy, energy transfer, and collision. They'll explore ways of using observation skills as they anticipate the outcomes of changes in energy during a collision, describe the relationship between energy and speed, and predict how energy moves from place to place. They'll also broaden their understanding of energy conversion (potential and kinetic) by investigating a solution that converts energy from one form to another, testing the solution to improve and refine its function.	Materials: ● Teacher/instructor lesson plan ● Teacher/instructor Google Slides presentation ● Teacher computer with access to internet and teacher presentation ● Student computers with LEGO Education SPIKE App ● LEGO Spike Essential kit (one per two students) ● LEGO Minifigure Bio copy (one) ● Printed building instructions (optional)

SLIDE 1:

Display the RoboMasters info. Allow students/guardians time to scan the QR code for website access.

SLIDE 3:

Share basic definitions for the following words: *impact, kinetic energy,* and *target.*
- *Impact:* a collision
- *Kinetic Energy:* moving energy
- *Target:* a goal to be achieved

Discussion Questions:

Have students give examples of each:

Impact - Two cars crashing into each other, players colliding during sports games, a bowling ball hitting pins

Kinetic Energy - A ball rolling down a hill, riding a bicycle, a roller coaster moving

Target - Specific goals (finishing this LEGO build and program, receiving an A in math class); discuss how to achieve the goal

SLIDE 4:

Go over each step of the engineering design process. Tell students "As you're working today, think about what step(s) in the EDP your activities fall into."

You will revisit these steps later in the lesson.

SLIDE 5:

Facilitate a quick discussion about energy changing from potential (stored) to kinetic (motion) energy.

Talk with your students about what happens to a ball's energy right before it's set in motion.

Discussion Questions:
- **Which ball has more energy: a ball that isn't moving or a ball that's rolling down a hill?**   A ball that's rolling down a hill due to its speed
- **How could you change the energy of the ball?** The ball could collide with another object (a rock, grass, a person, etc.)

SLIDE 6:

Introduce your students to Leo (using the LEGO minifigure bios) and the challenge: create and test the program that makes the ball stop at the target.

SLIDE 7:

Share the SOARing expectations for the LEGO kits.

SLIDE 8:

Distribute a Prime Essentials set to each pair of students.

Teacher/Instructor Note: It would be best to have pairs pre-selected.

SLIDE 9:
Have students open the LEGO Education SPIKE Essential App.
- Open the app
- Click SPIKE Essential
- Click Unit Plans
- Click Crazy Carnival Games
- Click Avoid the Edge

SLIDE 10:
Students will read/listen to slides 1 through 3:
1. Leo notices a new game being revealed. He's eager to try it.
2. It looks challenging, but Leo thinks he can figure it out. He wants to be the first one to win this game.
3. Build a new game like Leo's and try to win!

SLIDES 11 and 12:
Have students navigate to Kahoot.It and play the Kahoot about the Intelligent Hub.

Teacher/Instructor Note: You will have to navigate to Kahoot.It and "start" the Motors Kahoot to get the students' game code.

Go over the correct answers on Slide 12.

Answers:
What other two pieces from our LEGO kits can we connect to the Hub? Sensors and motors
It acts like a _____ _____, since it brings everything together! Central station
How many ports does it have? Two
It has a built-in _____-sensor. Gyro
What type of battery does it have? Rechargeable

SLIDE 13:
Only go over this slide if students were not able to recall the information on the previous slide.

SLIDE 14:
Tell students that they are now going to build their game. Explain to students that if they do not follow each direction exactly as shown, their game will not work properly.

SLIDES 15-18 and 22-37:
On Step 4, students will go through all twenty building steps in pairs using their Spike Essentials kits.

Circulate the instructional space to ensure students are building correctly.

Teacher/Instructor Note: There is a picture of each building step on a separate slide in the presentation.

SLIDES 19, 20, and 21:
Have students navigate to Kahoot.It and play the Kahoot about the Color Sensor.

Teacher/Instructor Note: You will have to navigate to Kahoot.It and "start" the Color Sensor Kahoot to get the students' game code.

Answers:
It detects _____ and _____ off a surface. Color and reflection
Its user can program creations to react to their _____. Environment
Give me an example of what its user can program its build to do.
Example: the build will only pick up items of a certain color
Example: the build will sort items based on color
Example: the build will knock over items based on color

Only go over slide 21 if students do not recall the information from last week on the previous slide.

SLIDE 38:
Step 5 provides students with today's challenge: create the program that makes the ball stop at the target. It can't roll over the edge!

SLIDE 39:
Step 6 has students connect their Hubs to the Spike Essentials App using the white USB cable.

Pictures are included on the slide of where to connect the cable into the Lego hub.

SLIDE 40:
Students will begin their coding sequence. The App is interactive and shows students exactly which coding blocks to drag into the work area.

They will end up with this sequence:

SLIDE 41:

Students will click the yellow PLAY button when directed to, to test their program.

Ask students, "What happened? How can we modify our code to be more successful?"

SLIDE 42:

Provide students with time to modify and re-test their codes to get the ball to stop in front of the target.

Teacher/Instructor Note: Students will need to change the speed % in the first blue block.

SLIDE 43:

After the students complete this challenge, they'll be provided with three Inspiration Coding Blocks to help them modify their programs.

The Inspiration Coding Blocks are intended to spark their imaginations as they experiment to find their own solutions.

SLIDE 44:

Have the students iterate and test their models to complete the next two challenges in the app:

- Modify the program to improve the game.
- Upgrade your bat and see how it impacts the game.
    - The Inspiration Images are to help spark their imaginations as they experiment and change their models.
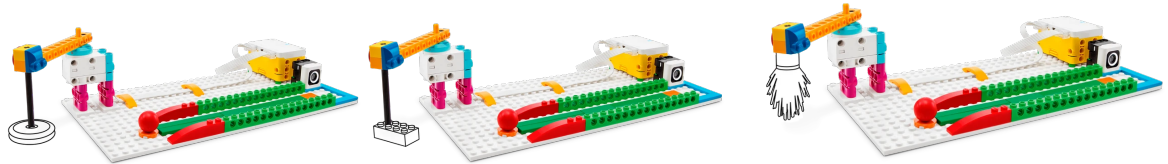
Teacher/Instructor Note: There aren't any building instructions for this challenge.

SLIDE 45:

Host a debrief discussion to reflect on the completed challenges. Ask questions like:

- ❖ **How did you modify your program to make sure the ball stopped at the target?**
    - ➢ They should've changed the speed % in the first blue block.
- ❖ **How did changing the bat affect the game and the ball's energy?**
    - ➢ Changing the bat affected the direction the ball was hit in, the path the ball followed, and how far the ball traveled.
    - ➢ The speed % had to be modified for various bats.

SLIDE 46:

Display the RoboMasters info. Allow students/guardians time to scan the QR code for website access.

SLIDE 47:

Ask students, "How does today's activity connect to robotics?"

SLIDE 48:

Provide students with ample clean-up time, helping to ensure they are separating all pieces and placing them back appropriately.