1. Mini Mini-Golf

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 the basic principles of energy and their connection to an object's speed. ● We will identify and describe the relationship between speed and energy. ● We will engage effectively in a range of collaborative discussions.	**Standards:** **3-PS2-3:** Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. **4-PS3-3:** Ask questions and predict outcomes about the changes in energy that occur when objects collide. **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. **MS-PS2-1:** Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
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: *energy, motion, program, test,* and *upgrade*.

- *Energy* - the ability to do work
- *Motion* - a change in position
- *Program* - A set of steps that are completed in order to achieve a task
- *Test* - Measuring the capabilities of something
- *Upgrade* - To improve

Discussion Questions:
Can you provide an example of each?
Energy - potential energy, kinetic energy, thermal/heat energy, etc.
Motion - have students show motion
Program - how to sharpen a pencil, a code for a sequence of buttons to push on the remote, steps to win a video game, etc.
Test - discuss how engineers test items to ensure they're designed well and they test robots to see if they can complete tasks
Upgrade - upgrading a cell phone, upgrading a car, making something better

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 how an object's speed is related to the amount of energy it has.

Answer: The more speed an object has, the more energy it has.

Discussion Questions:

- Talk about a moving ball (e.g., a ball that's rolling down a hill or being kicked across a soccer field).
- **Which ball has more energy...a ball that isn't moving or a ball that's rolling down a hill? Why?** The ball that's rolling down a hill because it has more speed and can cause more damage to something it runs into than the ball that's not moving.
- **How could you change the energy of the ball?** You could interact with it.

SLIDES 6 to 9:

Introduce your students to the story's main characters (using the LEGO minifigure bios) and the first challenge: trying to get a hole in one with the mini-golf game.

SLIDE 10:

Share the SOARing expectations for the LEGO kits.

SLIDE 11:
Distribute a Prime Essentials set to each pair of students.

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

SLIDE 12:
Have students open the LEGO Education SPIKE Essential App.

- Open the app
- Click SPIKE Essential
- Click Unit Plans
- Click Crazy Carnival Games
- Click Mini Mini-Golf

SLIDE 13:
Students will read/listen to slides 1 through 3:

SLIDE 14:
Go over Newton's Third Law of Motion with students.

Play the video. Be sure to maximize it to view full screen.

Discussion Question:
How do you think this law of motion relates to our mini-golf LEGO game today?

SLIDE 15:
Tell students that they are now going to build their mini mini-golf hole. Explain to students that if they do not follow each direction exactly as shown, their game will not work properly.

SLIDES 16-35:
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.

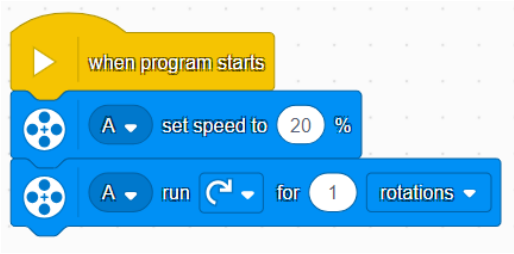
SLIDE 36:
Step 5 provides students with today's challenge: create the program to get a hole in one.

SLIDE 37:
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 38:

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 39:

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

Discussion Questions:

What happened? The ball does not travel far enough.

How can we modify our code to be more successful? We will change the % field in the middle coding block to 80-90%.

SLIDE 40:

Briefly review each step.

Discussion Questions?

What steps have we completed so far? By doing what?

Ask - To get a hole in one

Research - read about Lego figures

Imagine/Plan - Looked at LEGO design picture to see the design

What steps do we have yet to do? How do you think we'll do that?

Create - Follow the steps on the LEGO app to build and code

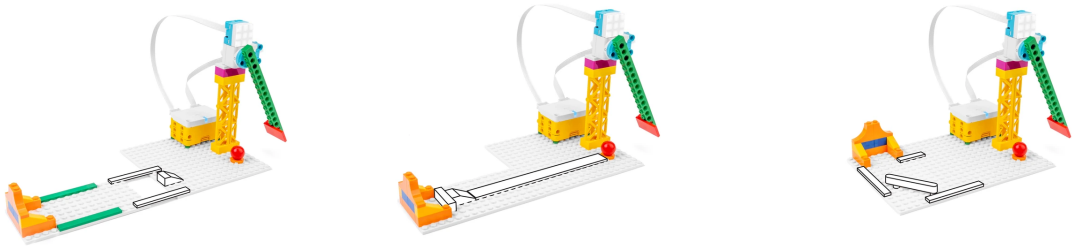
Test - see if the code promotes a hole-in-one

Improve - if not, modify the code for a hole-in-one

SLIDE 41:

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

- Modify the program to improve the mini-golf game.
- Upgrade the mini-golf game to make it more challenging.
    - After students complete this second challenge, they'll be provided with three Inspiration Images and an open-ended prompt for improving their models.
    - 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 42:

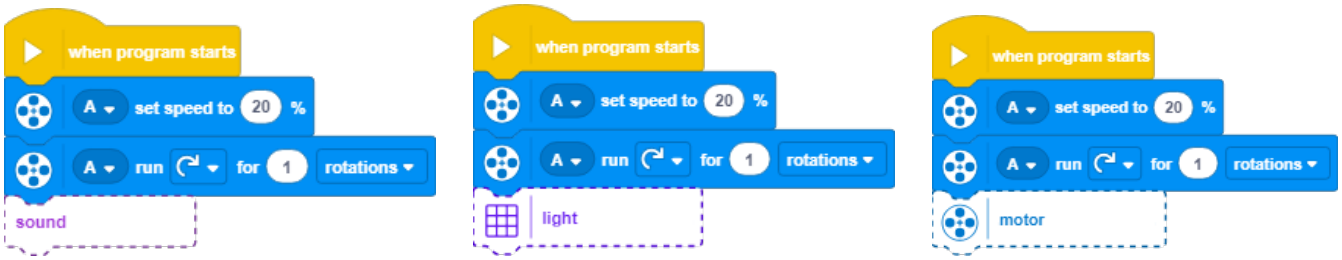
Provide students with time to modify and re-test their codes to get the ball into the opposite end of their mini mini-golf hole.

Teacher/Instructor Note: Students will need to change the % field in the middle coding block to 80-90%

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:

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

- **How did you modify your program to make sure the ball had enough energy to get a hole in one?**
  - Changed the speed of the motor (which controls the golf club) from 20% to approximately 80-90%
- **How did the speed of the mini-golf club affect the ball's energy?**
  - The higher the speed of the motor/golf club, the more energy the ball had.

SLIDE 45:

Prompt your students to discuss and reflect on the relationship between an object's speed and its energy.

Discussion Questions:

- **What could you do to an object to increase the amount of energy it has?**
  - Increase the force applied to the object to increase its speed, therefore increasing its energy
- **Why is it important to know about the relationship between speed and the amount of energy an object has?**

- ➢ The higher an object's speed is, the more energy it has.
- ➢ It is important in understanding the behavior of objects in motion.

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.