LESSON

RVR + littleBits: Trailblazer

Overview

RVR is ready for adventure! But things keep getting in its way. Good thing you have a way to help it clear its path. Using RVR and the littleBits STEAM Student Set, you'll create a maze with obstacles, use RVR to program through the maze, and build a trailblazing invention with littleBits to keep RVR from hitting any of the obstacles.

THE CHALLENGE

Create a maze with obstacles, then use RVR to program through the maze and littleBits to keep RVR from hitting any obstacles!

Lesson Tags

GRADE LEVEL:

Elementary, Middle (grades 3-8)

SUBJECTS:

Technology, engineering

DIFFICULTY:

Beginner

DURATION:

2 x 50 minute class periods

PREREQUISITE KNOWLEDGE:

- littleBits basics
- littleBits Invention Cycle
- Sphero RVR basics

Supplies

Technology:

- Sphero RVR
- littleBits STEAM Student Set

Other Materials:

- Assortment of craft and recycled materials

Tools Used:

- Maze tape/Painter's tape
- Scissors
- Pencil/pen

Description

LESSON OUTLINE:

INTRO: Introduce the lesson prompt and assess students' current knowledge.

CREATE: Groups of 2-3 students brainstorm ideas and create a plan for their RVR and littleBits designs. Then, they will build their prototypes.

PLAY: Students test their prototypes.

REMIX: Students adjust and customize their designs to improve functionality.

SHARE: Students run their new inventions through the obstacle maze and share their work with the class!

LESSON OBJECTIVES:

- Demonstrate a basic understanding of input/output and electric current.
- Program the RVR to successfully navigate a maze.
- Construct an invention with littleBits that helps the vehicle avoid obstacles.
- Modify the vehicle to make it work more effectively.
- Share the invention with the class!

ASSESSMENT STRATEGIES:

FORMATIVE ASSESSMENT: Testing, feedback, and redesign provide excellent opportunities for formative assessment. Circulate the classroom as students work, assessing their use of the RVR and Bits, teamwork, and any other relevant skills you wish to focus on.

SUMMATIVE ASSESSMENT: Evaluate students understanding and completion of final projects during the "Share" portion of the lesson.

Documentation for this lesson can be achieved through:

- A log of their invention / exploration process - whether written in a journal/notebook or through the use of media
- A presentation or media component capturing their process (image or video)

Standards

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.

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.

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.

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Vocabulary

Maze	Obstacle	Prototype
Navigate	Trailblazer	

Resources

SUPPORTING LINKS

Sphero RVR + littleBits - Trailblazer

ATTACHMENTS

Maze Template

TIPS & TRICKS

Tip #1: Keep an eye on the clock. Some students will want to spend too much time in the Create stage, and some students will try to speed through it.

PACING (2 x 50 minute class periods)

Day 1

Prep + Setup

Intro (10 mins)

Create (30 mins)

Play (5 mins)

Close (5 mins)

Day 2

Prep + Setup

Intro (5 mins)

Create (15 mins)

Play (5 mins)

Remix (5 mins)

Share (15 mins)

Close (5 mins)

Instructional Steps

Step 1: SETUP

DURATION: 15 minutes prior to class

This lesson can be done individually or in small groups (2-3 students).

Each group will need one Sphero RVR and one littleBits STEAM Student Set. Additionally, this activity will require students to work with a maze set-up in the classroom. You may use the maze template provided or design your own setup prior to class. Depending on student's levels and materials/space available, you may allow students to design the maze themselves, just be aware that this will take more time than what is mapped out in this lesson plan. Make sure the maze is wide enough for the RVR to navigate through it without touching the lines. If you have tiled floor or carpet tiles, you can use those blocks to help set up the maze. Set up a central location in the classroom for assorted materials and tools.

NOTES

- You should use a classroom timer or digital timer to help keep students on track.
- Optional devices for documentation: point and shoot cameras, cell phones, computer/tablet cameras, voice recorder.

Step 2: INTRODUCE

DURATION: Day 1: 10 minutes, Day 2: 5 minutes

Day 1

Begin by discussing different vehicles that can be work as "trail-blazers". Elicit a discussion on what tools and machinery allow for machines to move through obstacles safely.

Ask: What are some vehicles you know that can move or avoid obstacles?

Discuss: Allow for students to share their ideas, then discuss examples of vehicles they know that can move objects, such as bulldozers and cranes.

Ask: What do these vehicles have that make them unique from regular cars or trucks?

Discuss: Allow for students to share their thinking, prompt them to think about the machinery that these vehicles have that makes them unique and allows them to avoid obstacles. For example, bulldozers have a large shovel-like attachment in the front that allow for them to push objects out of the way.

Now, ask students to think about the term “trailblazer”. Ask if they know what this word means, then discuss how it refers to something that can clear a trail of obstacles to lead the way for others!

Introduce the Challenge

Explain that students will combine their RVR and littleBits to create a trailblazing invention that will be able to navigate a maze and avoid obstacles! They will program their RVR to move through the maze, then use littleBits and the littleBits Invention Cycle to transform their RVR into a trailblazing pioneer. The activity will be broken up into the following steps.

> **CREATE:** Program the RVR to move through the maze, then use littleBits to allow the RVR to move through or avoid any obstacles in its path.
>
> **PLAY:** Test your invention for modifications. What worked, what didn’t work? It’s 100% OK if there are issues - that’s how inventions are built!
>
> **REMIX:** Use this time to make changes to your inventions.
>
> **SHARE:** Share their inventions in a presentation (or through video/photos posted online).

Then, walk through the learning sequence, and the learning targets. Show students the maze that they will have to navigate through. Finally, divide the class into groups of 2-3 and have them set up their workstations.

NOTE:

- If you did not map out the maze ahead of class and are allowing students to design their own maze, you can do so during this portion of the lesson.

Day 2

Briefly remind students of expectations and where they should be in the Invention Cycle.

Step 3: CREATE

DURATION: Day 1: 30 minutes, Day 2: 25 minutes

Day 1

Program RVR

Now that students are away of the layout of the maze and the challenge ahead, have them program their RVRs to roll through the maze without touching any of the lines. Do:

- Use **roll blocks** to roll RVR in a specific heading
- Use **delay blocks** to allow RVR to come to a complete stop before changing heading
- Add **main LEDs** and **Sounds** to your program (try a neat storytelling sound to begin the trailblazing adventure!)

After students have successfully programmed RVR to navigate the maze, create a challenge for them to complete. Add obstacles like cups, markers, or other school supplies to have them navigate through the maze without RVR's body coming in contact with any of the objects. Consider how the type of obstacle will require different types of problem solving. An object that sits low to the ground versus something that stands taller.

NOTE:

- For extra help, check out the getting started activities for RVR on Sphero Edu.

Brainstorm and Design with Bits

Once students have run their RVR through the maze successfully, they can begin brainstorming their littleBits invention. Show them the obstacles they will need to avoid or move in the maze to spark their thinking. Guide students to consider the following:

1. How will they use Bits to clear a path or avoid an obstacle?
    a. Consider how lights, sound, sensors and/or motion Bits can be integrated into their project in order for them to achieve success.
2. How will they build and attach their Bits to the RVR?
    a. What other materials will they need to combine their RVR with their Bits?

Students should draw a prototype of their trailblazer, labeling how their Bits will assist RVR in completing the maze challenge. Tell them they shouldn't worry about perfection! A quickly drawn prototype that shows an understanding of the invention works is enough for this step.

To help students, guide conversation around how certain obstacles can be avoided or moved to clear the path. For example, if there is a heavy item blocking the path, this would be better to avoid then try and move. Students should think about what sensors and outputs could be used to detect this and send an alert that the rover should move around it. On the other hand, if there are lighter objects blocking the RVRs way, students could consider how Bits could move these objects with sweeping or pushing motions. Here are some invention ideas in case students are stuck:

- littleBits Truck Crane
- littleBits Garbage Truck
- littleBits Sweeping Rover

NOTES:

- There will be time during the next session to build the trailblazing inventions. However, by the end of this lesson students should at least have an idea of how they will use their Bits and attach them to the RVR to create their trailblazing vehicle.
- Delegate! Recommend to students that they should divide the work among group members. For example, one student works as the record keeper, one works as a timekeeper, one on the RVR program, one on the Bit behaviors etc.
- For younger students, having a limited supply of materials can be helpful constraint, especially since they are building both the body of a creature plus its environment.

Day 2

Build with Bits

Students should dive right into the second session of this lesson building their trailblazing inventions with their Bits! Remind students to consider how they want their Bits to navigate the obstacles, how they will attach their new inventions to the RVR, and what extra materials they will need.

Step 4: PLAY

DURATION: Day 1: 5 minutes, Day 2: 5 mins

Day 1

Test RVR Program

Have students take their RVR on a test-drive! Allow for students to take turns sending their programmed RVR through the maze to see if it works. Is there anything they need to adjust or change?

Day 2

Test the Trailblazer

Have students test out their new RVR + littleBits trailblazing invention. Did everything work the way they planned? What could be better?

NOTES:

- If time allows, have students share their creation with another group and collect feedback on what could be improved.
- You may wish to set up a protocol for students testing their inventions in the maze, as it could get hectic! You could allow for students to get only a certain number of test-runs, or a certain amount of time, before they must let another team go so everyone can get enough time to test their prototypes.
- Remind students to focus on the successes of their inventions during this time as well! While this time is meant for students to identify aspects that can be improved with their projects, they should also take some time to revel in their trailblazing inventions!

Step 5: REMIX

DURATION: Day 2: 5 minutes

Students should use this time during the beginning of the last session to make any improvements and changes to their inventions. What will they improve about their inventions? Guide them to implement changes and run their RVRs through the maze again to see if the changes helped.

NOTES

- Keep your eyes peeled for any groups going into meltdown mode thinking “Our prototype is terrible! Tear it apart!” If a group is disappointed with how their invention is going, celebrate their efforts and emphasize failing forward - e.g. learning from mistakes.

Step 6: SHARE

DURATION: Day 2: 15 minutes

Showcase Inventions

Have students set up their trailblazers and take turns demonstrating their work. If time allows, let students run their inventions through the maze for the class. If you are crunched for time, this can also be done by having students choose a small portion of the maze to run through (only 1-2 obstacles) for the class.

Step 7: CLOSE

DURATION: Day 1-2: 5 minutes per class

At the end of each class, have students return their RVR, Bits and any other materials to their designated areas.

Students should take apart their inventions and put away the Bits according to the diagram on the back of the Invention Guide. Students should clean up their workspace and return any usable materials/tools.