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RVR + littleBits

MARS MISSION

COACHES GUIDE

sphero.com/pages/global-challenge

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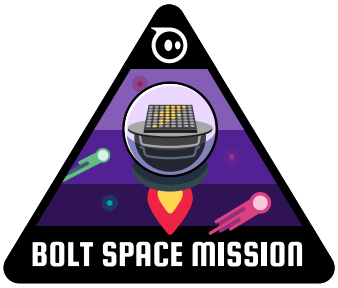
INTRO TO SPHERO GLOBAL CHALLENGE

Our mission at Sphero is to inspire the creators of tomorrow. With Sphero Global Challenge (SGC), students are engaging in problem solving, computational thinking, collaboration, and more. The SGC provides an opportunity for students to compete with other students around the world with the top teams from each country invited to participate in a live competition next spring. To see qualifying criteria, please refer to the Competition Rules and Competition Rubrics documents. We believe that this challenge will provide students many opportunities to have fun and build lasting memories. We encourage you, as a coach, to invite as many students to participate as you can. The weekly guides will help all students participate fully, regardless of their experience level.

This coaching guide will give you some tools and the structure to guide your students through the RVR+littleBits Mars Mission event. However, with your registration, your team can compete in the other events as well, so we encourage you to explore these coaches guides and challenges to see how your students can take advantage of the Overall Performance Score judging criteria as outlined in the Official Rules Document for the best chance of becoming a finalist.



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RVR + littleBits

MARS MISSION

Your Martian RVR is ready for its missions!

Gather some friends and create or join a team! It doesn't matter your ability level, there will be things that anyone can help with, and what better way to learn something new!

This is the moment your team has been working towards. RVR is stationed on Mars and is expecting a supply mission to land. Program RVR and design, build, and engineer solutions with littleBits to complete all of the objectives for a successful Mars resupply mission.

There will be objectives that your team will need to complete by programming RVR to navigate around the game field and by building littleBits inventions to interact with the physical world.

- Lift, push, or pull objects
- Create physical interactions with the Martian environment
- Program RVR to autonomously move in space just like you were controlling a real Martian rover.

During the challenge season, you will document your learning in your engineering journal. Each team will showcase the mission objectives by submitting program code, providing a video of their RVR and littleBits inventions completing the outlined challenges, and completing a creative challenge.

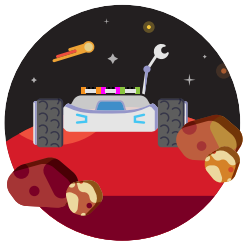
RVR+littleBits Mission Overview

The below Mission Objectives are high level overviews of goals for each Mission Objective. For detailed rules please refer to RVR-M1-5 in the Official Rules document.

Mission Objective #1

Survey & Patrol your Base

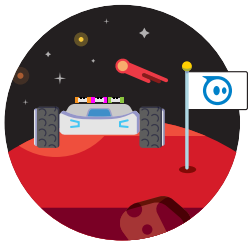
In this Mission Objective, RVR must be programmed to navigate around the Competition Field while avoiding martian terrain areas. Engineers can build a bridge over martian terrain Obstacles. During this Mission Objective, students must build a littleBits invention that is placed in the Competition Field, and RVR must interact with that invention.



Mission Objective #2

Prepare the Landing Zone

There has been a massive dust storm, and many rocks and debris are obstructing the landing zone for the resupply mission. Program RVR to clear the landing zone with a littleBits invention. Be careful though, RVR is fragile and cannot touch the debris in the landing zone. Make sure that your littleBits invention is doing all of cleanup.



Mission Objective #3

Relocate Supply Cargo

RVR has received the cargo from the resupply mission, but it needs to be relocated out of the landing zone. Program RVR with an attached littleBits invention to relocate the Cargo to the designated Cargo Areas.

Mission Objective #4

Rescue Your Martian Friends

RVR will travel the Competition Field to rescue two student made Martian Friends and return them to the Base.

Mission Objective #5

Creative Simulation

This is an open-ended Mission Objective. Teams are tasked to come up with a computational model or simulation of a scenario/problem for using the sensors of RVR & a littleBits invention.

MATERIALS FOR COMPETITION

In order to complete all of the missions of the RVR+littleBits Mars Mission, you will need to have the following items:

Required Materials for Competition:

Sphero RVR

Sphero RVR+littleBits Topper Kit

Access to Sphero Edu app and a programming device

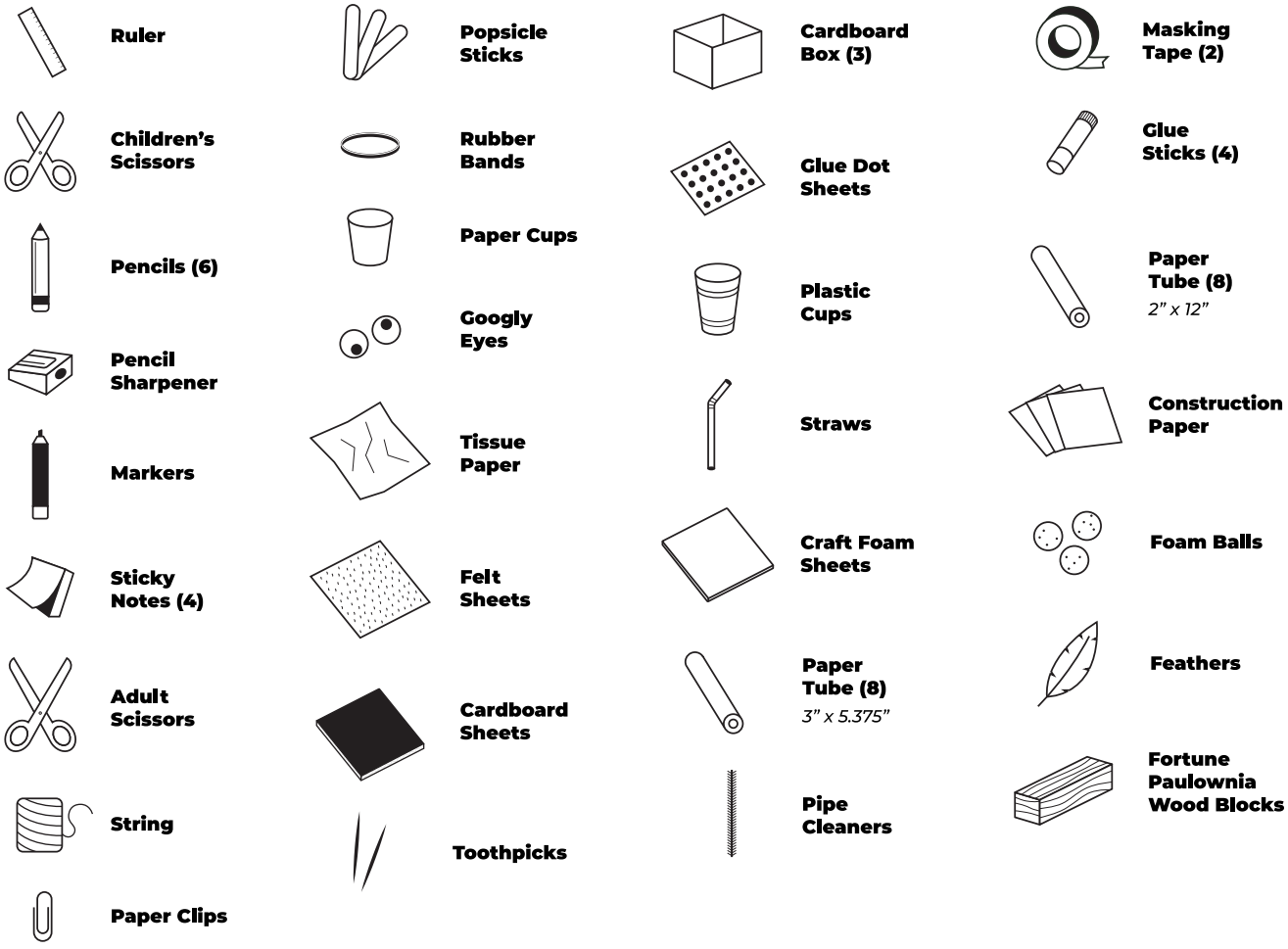
10’ x 10’ (3.048m x 3.048m) hard & flat surface for a Competition Field

Various Craft Supplies to build with (all available in the Sphero Craft Pack)

Recommended and additional items for completion:

Sphero Craft Pack

micro:bit



SUBMISSION GUIDELINES

Teams will be required to submit three items. Please see the Sphero Global CHallenge Official Rulesbook and Evaluation Rubric for specifics on how each submission will be evaluated and judged.

1 Program File

a. Program file should contain a function for each Mission Objective.

b. Use the following naming convention for your functions on the final code submission.

i. rvrMo1

ii. rvrMo2

iii. rvrMo3

iv. rvrMo4

v. rvrMo5

2 Video of each Mission Objective combined into one video submission

a. Mission Objective videos should not be edited or spliced. Mission objectives should be filmed in one take.

b. After all Mission Objective videos have been recorded, please combine them using a video editing software to be one video. You may edit the final submission to have captions or titles, but please do not add sound effects or music to the background of the recordings of the Mission Objectives.

3 Code and Engineering Design Packet

a. An infographic of the learning process must be submitted as part of the code and engineering design packet. Infographic must be submitted as a .pdf file.

i. An infographic is a visual representation of an idea, process, or a dataset. You are responsible for creating an infographic that demonstrates the learning process over the course of the event.

1. How did the team work together?
2. How did you iterate on your ideas?
3. What was a struggle?
4. What was easy?
5. What did your team learn throughout the process?

b. One page description with one of the following for each Mission Objective.

i. A workspace from the FUSE app for each littleBits invention used with callouts to identify how each bit is used as part of the Mission Objective.

OR

ii. A picture of your invention with callouts to identify each bit and how it is used as part of the Mission Objective.

TEAM ROLES

Programmers

Programmers are responsible for making sure that your RVR robot does exactly what you want it to do. A programmer can also work with the littleBits micro:bit adapter for another programming task.

Engineers

The engineer is responsible for the building of the littleBits inventions and other competition objects and placing them in the field based on the competition rules.

Debuggers

The debugger is an expert at troubleshooting. They are responsible for asking questions and coming up with procedures for solving problems with the code and/or engineering.

Mission Manager

The mission manager is a leader. They are great at bringing the team together to come up with plans and lead brainstorming sessions on how to approach each Mission Objective. Mission Managers should also be experts in the rules of the competition to ensure the team is in compliance with all of the rules and regulations.

Designer

The artist/creative team gives your mission and objectives that extra flair! Artists have an eye for making things beautiful and awesome. The designer can also be the videographer and help with coordinating the infographic and design packet for final submission.

RESOURCES

How to Use the Coaches Guide

This coaches guide will help you navigate your students through each objective of the BOLT Spacecraft Mission. This guide can be used as a template for lesson plans if you are incorporating the competition into your daily teaching plan, but it can also be used with after-school clubs. There isn't a required amount of time that you should spend on the completion of each objective, so students can move on to the next session if they're ready for it.

Each Mission Objective is broken down into two session types: learning sessions and work sessions. You can adapt these to your needs and provide more work sessions, or fewer learning sessions if need be. It is also very beneficial for the team coach to be established as a teacher in the Sphero Edu app so that activities can be assigned to the students and so that progress monitoring can take place on the Sphero Edu app.

Learning Sessions

The first session for each Mission Objective is geared towards learning a computer programming skill that will help students complete the mission. Learning sessions will be primarily students working through an activity in the Sphero Edu app to help approach the Mission Objective confidently.

Learning sessions are structured with the general outline of Exploration, Skills Building, Challenges, and Extended challenges. This allows students to dive into the concepts necessary to complete each of the Mission Objectives.

Working Sessions

Working sessions are designed to allow students time to complete the Mission Objective by applying their knowledge from the learning sessions. Think of this as project work time or Mission Objective completion time. The nature of these sessions are very open-ended, but coaches are given some framework and tips for guiding the students productively through the work session. After completing the learning sessions, students/teams may find that it would take 45-60 minutes to complete the challenge; however, some teams may wish to spend extended time on each Mission Objective to ensure they are submitting their best possible solution—this may require multiple working sessions.

RECOMMENDED MEETING SCHEDULE

Planning out your Competition Season Schedule

If you are working with your students from scratch in programming with RVR and littleBits, we recommend a minimum of 12-14 team meetings to address the learning needs of the students with programming and circuit building. If you are incorporating Sphero Global Challenge into your lesson plans, you can adjust to meet the needs of your classroom environment.

13 Meeting Agenda
1. Forming Teams
2. Intro to Invention Cycle
3. Intro to Programming
4. Challenge #1 Learning Session
5. Challenge #1 Working Session
6. Challenge #2 Learning Session
7. Challenge #2 Working Session
8. Challenge #3 Learning Session
9. Challenge #3 Working Session
10. Challenge #4 Working Session
11. Challenge #5 Learning Session
12. Challenge #5 Working Session
13. Work Session to finalize Submissions

9-10 Meeting Agenda
1. Forming Teams
2. Intro to Invention Cycle
3. Learning Session as needed
4. Learning Session as needed
5. Challenge #1 Working Session
6. Challenge #2 Working Session
7. Challenge #3 Working Session
8. Challenge #4 Working Session
9. Challenge #5 Working Session
10. Finalize submissions

If new to littleBits, but have some experience in Programming with Sphero

6-8 Meeting Agenda
1. Forming Teams
2. Challenge #1 Working Session
3. Challenge #2 Working Session
4. Challenge #3 Working Session
5. Challenge #4 Working Session
6. Challenge #5 Working Session
7. Learning Session as needed
8. Finalize submissions

For students experienced in programming with Sphero and inventing with littleBits.

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MARS MISSION

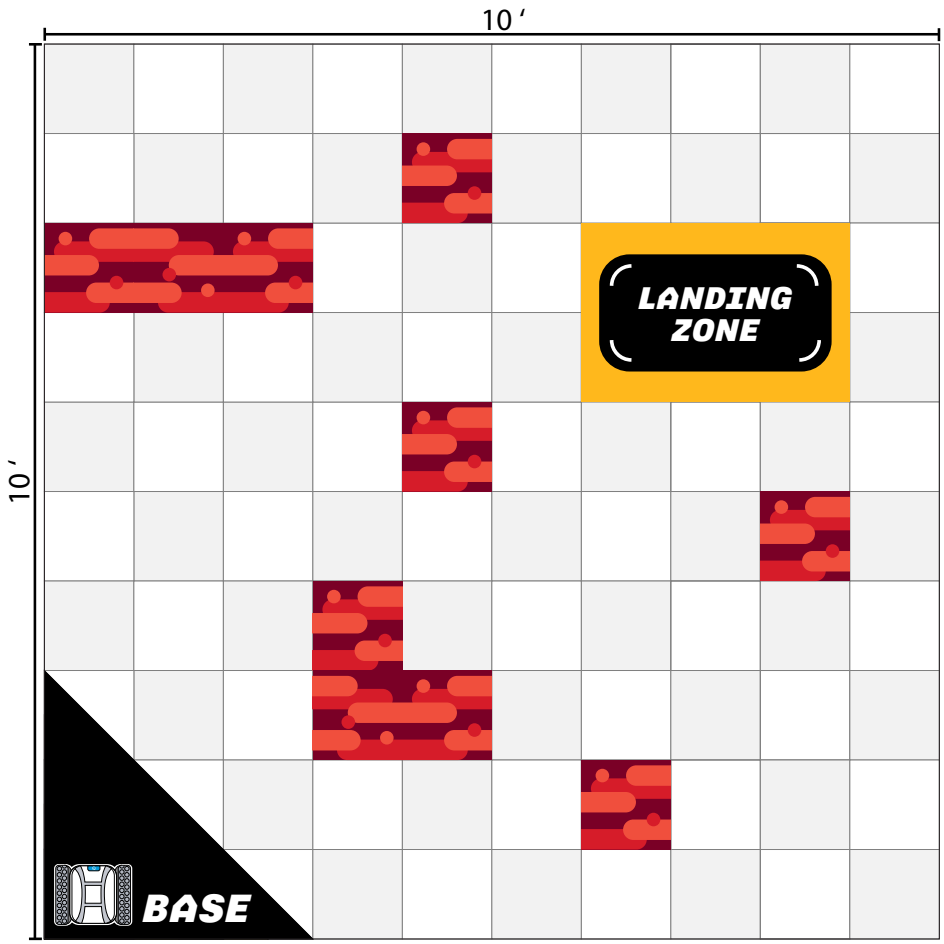
CHALLENGE GUIDE

COMPETITION FIELD SET UP

We recommend finding a way to have a semi permanent installation of the Competition Field so that you don't have to spend time setting it up each time your team plans to work on the Mission Objectives.

Competition Field Size: 10' x 10' (3.048 m X 3.048 m)

- Each grid on the field map is 1' x 1' (30.48cm x 30.48cm)
- You can use any material to mark the Competition Field
  - Mark the space with Painter's tape, PVC, 2x4s, etc. Except for the exterior boundary of the Competition Field, use the outer perimeter to measure out spaces.
- The black and red areas are martian terrains that RVR cannot navigate through/over. Establish this area by using tape to mark the boundaries of these areas.
- The Black and yellow triangle in the lower corner is RVR Martian Base and starting point. Establish this area by using tape to mark the triangle. Label it as base.
- The Blue and Black area is the Landing Zone. Establish this area by using tape to mark the outline of the landing zone.



OBJECTIVE #1: SURVEY + PATROL YOUR BASE

This is a high level overview of the Mission Objectives. Please refer to the Sphero Global Challenge Official Rulebook for a full explanation of the Mission Objective and Competition Field setups.

Objective

RVR must semi autonomously navigate the Competition Field to each orange area in the quickest path without crossing over any martian terrain areas. For bonus points, engineers can build a bridge over martian terrain Obstacles. During this challenge, students must also build a littleBits invention on the Competition Field that RVR must interact with. RVR must return to base by the end of the program.

Required Materials

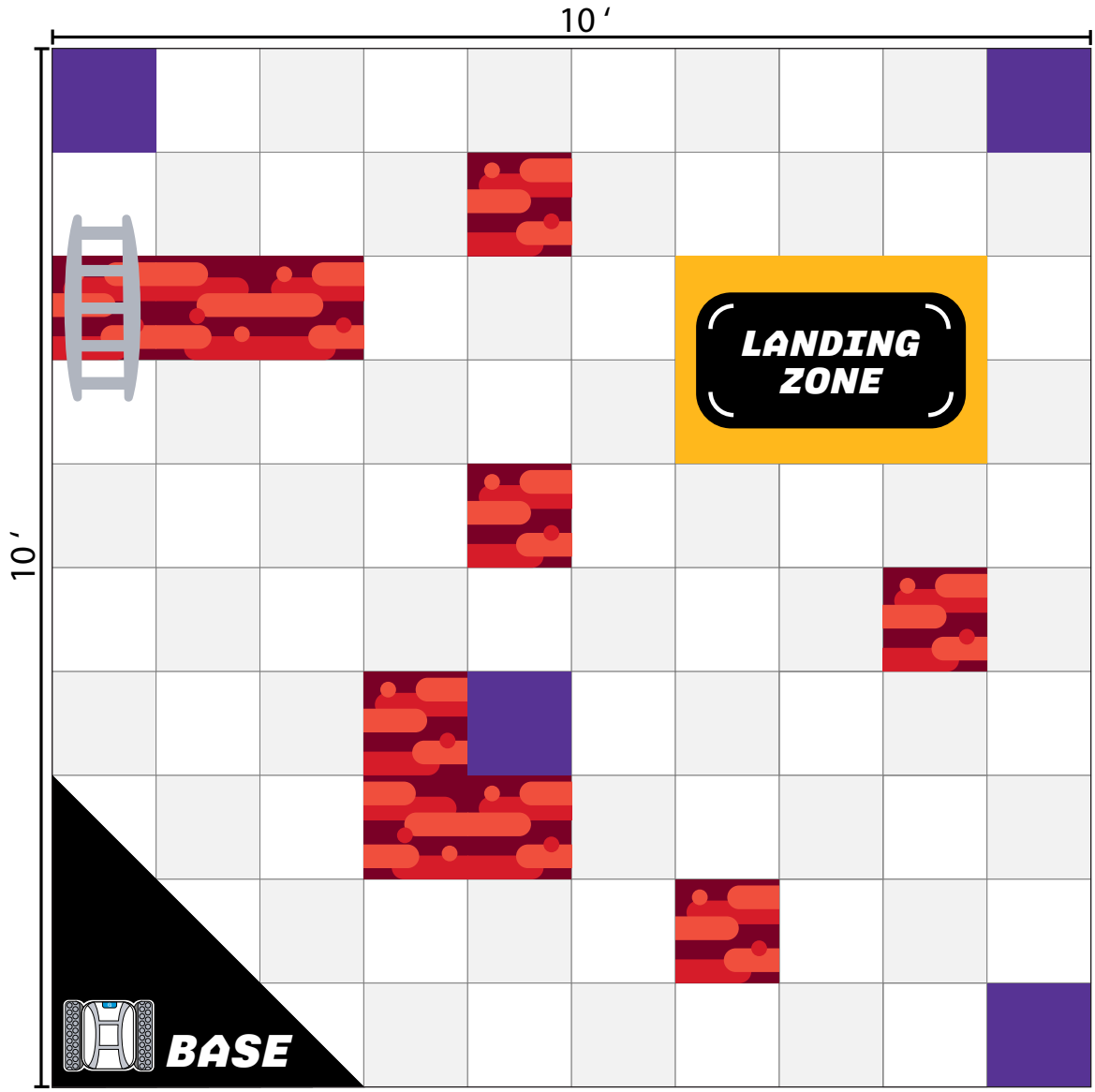
- RVR
- littleBits RVR Topper Kit Bits
- General Craft Supplies or Sphero Craft Pack

Bonus

Teams may opt to build a bridge over martian terrain to speed up the program. Bridges must rise a minimum distance of 5 inches off of the ground to be counted for bonus points on the rubric. For bonus points, RVR must travel over the student-created bridge.

OBJECTIVE #1: SURVEY + PATROL YOUR BASE

Competition Field Set-Up:



OBJECTIVE #2: PREPARE THE LANDING ZONE

Objective

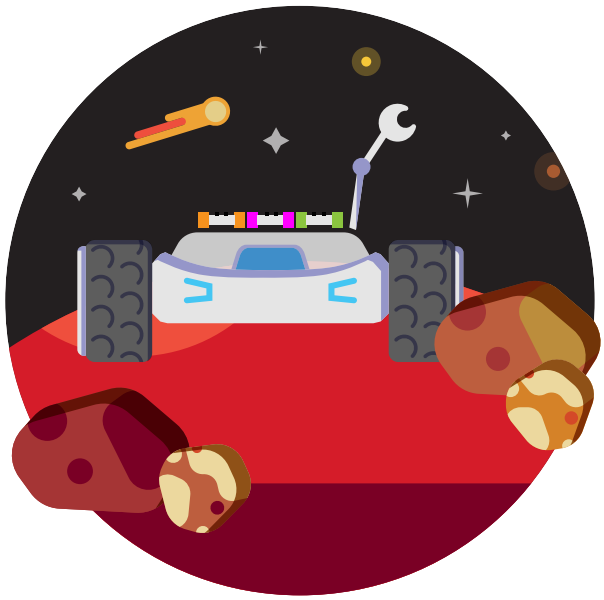
RVR must semi autonomously navigate to the landing zone and using a littleBits invention, clear the debris from the landing zone. RVR cannot touch the debris in the landing zone. All debris must be cleared from the specified landing zone for a successful mission.

Required Materials

- RVR
- littleBits RVR Topper Kit Bits
- 15 x 1” foam balls
- General Craft Supplies or Sphero Craft Pack

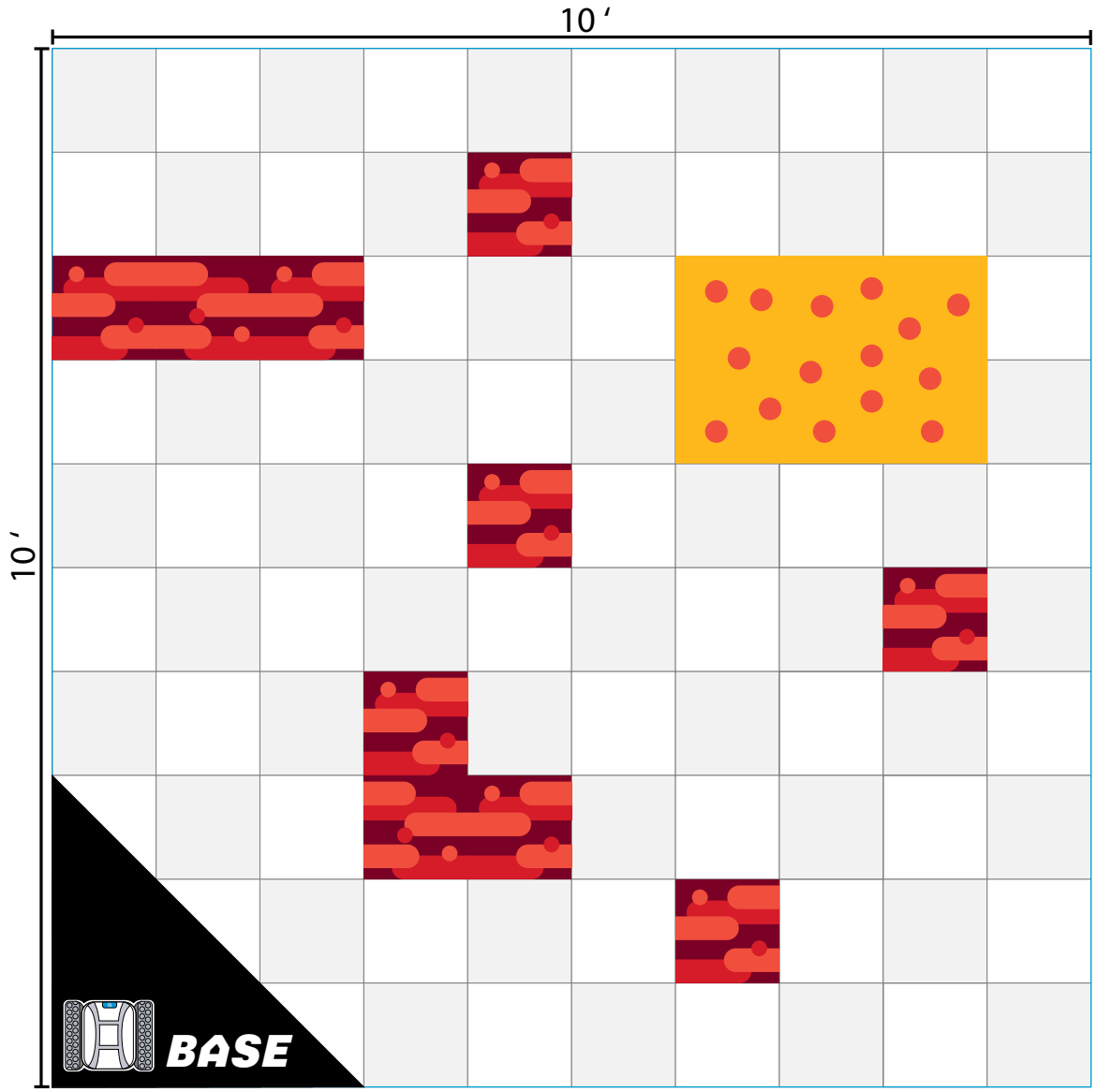
Set Up

Place 15 1” foam balls inside the Landing Zone - Ensure foam balls do not exit the landing zone before beginning the mission.



OBJECTIVE #2: PREPARE THE LANDING ZONE

Competition Field Set-Up:



OBJECTIVE #3: RELOCATE SUPPLY CARGO

Objective

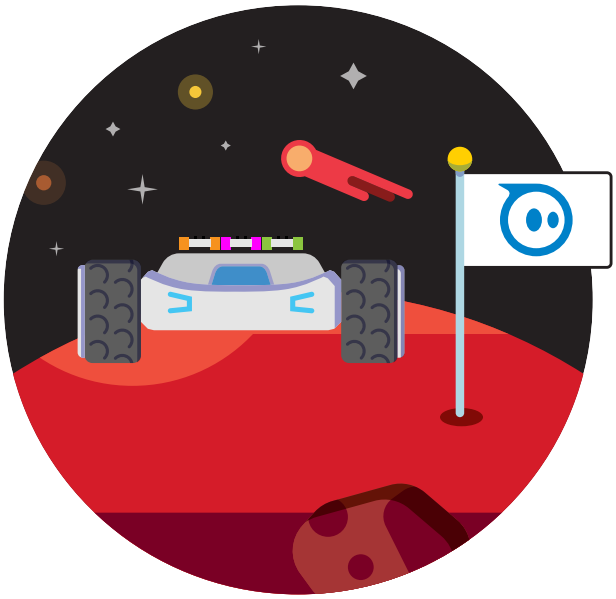
RVR must semi-autonomously navigate to the landing zone and using a littleBits invention, relocate each of the boxes into the specified cargo areas around the landing zone.

Required Materials

- RVR
- littleBits RVR Topper Kit Bits
- 4 pre-built boxes from Sphero Craft Pack or box made from scrap cardboard to measure 6”X 3.5”

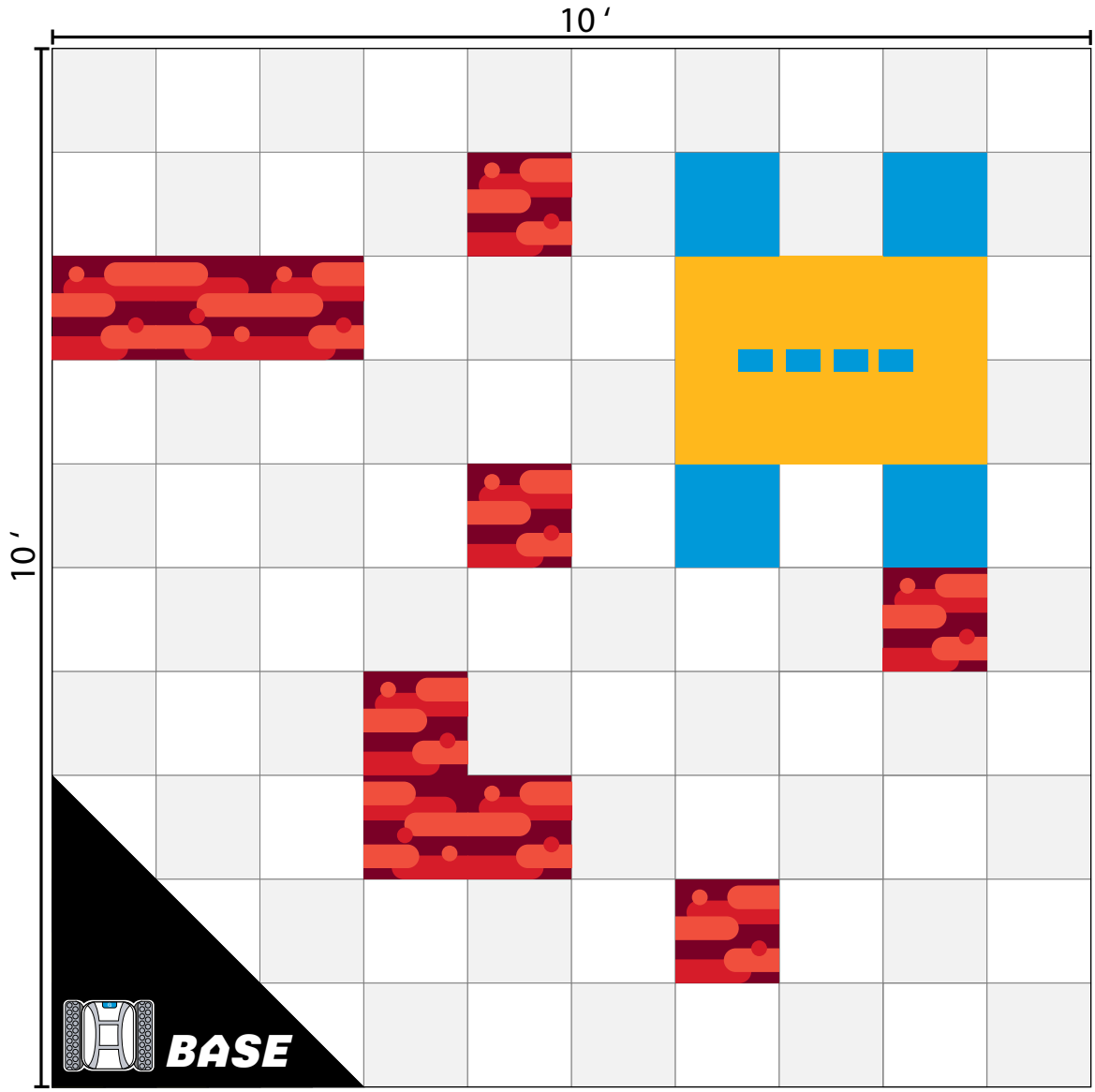
Set Up

Place 4 boxes inside the Landing Zone. Place each box in a line, 2 inches apart in the center of the Landing Zone.



OBJECTIVE #3: RELOCATE SUPPLY CARGO

Competition Field Set-Up:



OBJECTIVE #4: RESCUE YOUR MARTIAN FRIENDS

Objective

RVR must begin in the base and pick up your craft made martians and return them to the base. At the end of the program, once RVR has returned the martians to the base, the time elapsed sensor has to be used to announce how long it took to complete the objective (see rules document on specifics).

Required Materials

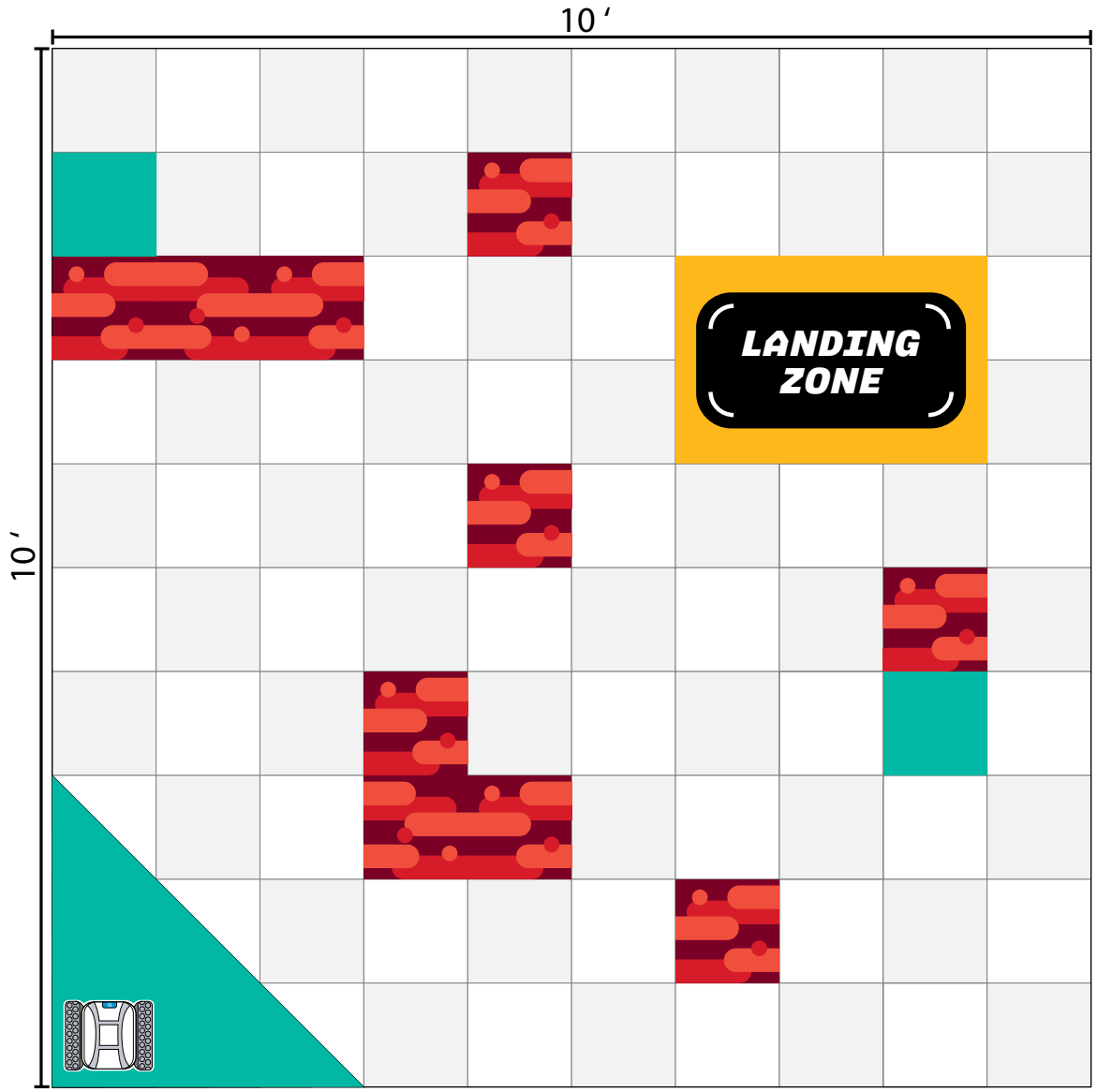
- RVR
- littleBits RVR Topper Kit Bits
- General Craft Supplies or Sphero Craft Pack

Set Up

Create 2 craft made martians and place those martians in the pink areas. RVR begins in the Base area of the Competition Field.

OBJECTIVE #4: RESCUE YOUR MARTIAN FRIENDS

Competition Field Set-Up:



OBJECTIVE #5: CREATIVE SIMULATION

Objective

This is an open ended challenge. Teams are tasked to come up with a computational model or simulation of a scenario/problem for using the sensors of RVR and interacting with a littleBits invention. Teams will develop the situation, a littleBits invention, and a program that moves RVR around in the Competition Field while avoiding martian terrain.

Required Materials

- RVR
- littleBits RVR Topper Kit Bits
- General Craft Supplies or Sphero Craft Pack

Set Up

RVR must begin in the base.

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MARS MISSION

MEETING AGENDAS

Teamwork Makes the Dreamwork

Mission Objective: Intro to the Sphero Global Challenge

Time Required: 45-60 minutes

Supplies Needed

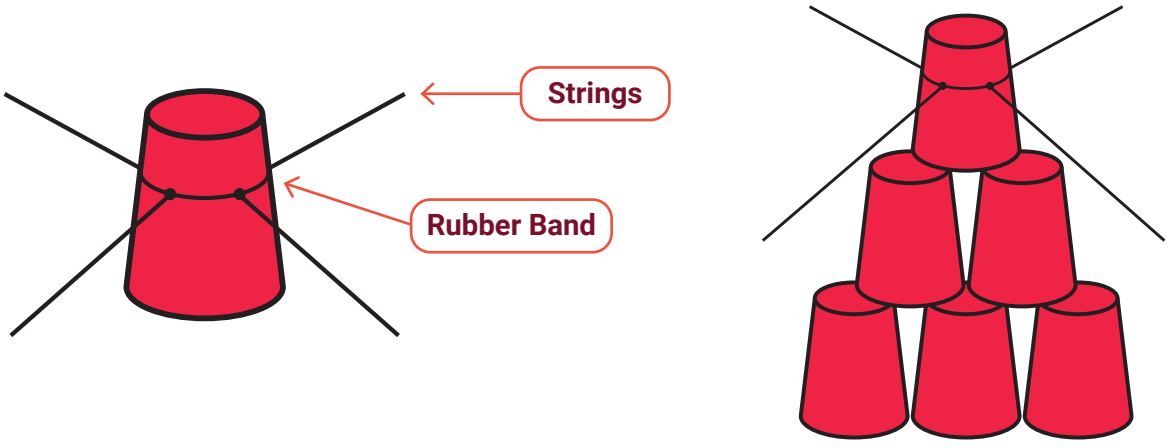
- Craft Supplies:
  - Rubber Bands
  - String
  - Cups
- Sphero Global Challenge Launch Video
- Sphero RVR & littleBits

Learning Objectives

- Students will be able to identify goals of the Sphero Global Challenge.
- Students will be able to work as a team to achieve a goal

1 Warm-Up

Using craft supplies create the following set up for your teams:



Using only one hand, students must work together to build Cup structures

1. Pyramid
2. Tallest structure in 60 seconds

2 Steps

Gather all of the materials and provide a way for students to view the **Sphero Global Challenge Launch Video**, specifically the Mars Mission objectives.

Discuss:

- What is being asked of you?
- What Mission Objectives do you anticipate being the most difficult?
- What Mission Objective looks like the most fun?

Explore:

Read through each of the challenges as a group and refer to the grading rubric as you read the challenges.

Discuss:

- How does each Mission Objective get evaluated?
- Are there points in which you can earn bonus points? How does that work?

Read through the different roles on page {#} of the Coaches Guide.

Take time to lead a discussion on how the team will contribute to the challenges:

- As a team, how do you want to handle different roles and responsibilities in the challenge?
- Is there a role that you are excited about? Is there a role that you aren't as enthusiastic about?
- Does your team want to keep the same role the whole time, or do you want to switch roles for each Mission Objective?

3 Wrap-Up

Share the suggested roles (or roles that you came up with on your own) and ask students to jot down their ideal role, or a backup role.

Teacher Tip

Use the feedback that students provide in this exit ticket as a way to structure the team going forward. If students have naturally selected a variation of all of the roles, you've got a well-rounded team. If everyone on the team wants the same role, you may need to spend some time planning out how each team member can participate in their ideal role over the course of the whole Mars Mission challenge.

AGENDA #2

The Invention Cycle

Time Required: 45-60 minutes

Supplies Needed

- STEAM Student Set or STEAM+ Class Pack
- Paper
- Phillips-head screwdriver
- Timer

Learning Objectives

- Create a circuit containing a power source, inputs, outputs and wires
- Identify and explain the value of each phase of the Invention Cycle

1 Warm-Up

Introduce the lesson objectives and the concept behind the challenge:

You can begin the lesson with some of the following questions to frame the activity:

- What do engineers and designers do?
- How do they figure out what to make?
- How do they make sure their projects work?
- What happens if the project doesn't work?
- How do they get better at the work they do?

Explain to the students that they are going to use Bits to complete a short engineering design challenge so they can experience how engineers and designers work.

Introduce the challenge to the students:

Using Bits and the provided craft materials, groups will need to move as many paper balls from one square (starting square) to the other (goal square). Each team will be given 15 minutes of work time to create and test their inventions. The final test will happen after this period. Each group will have one minute to move as many balls as they can from their starting square into their goal square.

Teams must agree on the following rules:

- They can only use their Bits and the construction materials provided.
- Balls can only be sent to the goal square if a littleBits circuit is causing them to move. Students cannot touch the balls on their way to the goal (e.g. students can use the Bits to push, throw, or carry balls to the goal, but can't throw or carry the balls themselves)
- At any point, students can add more balls to their starting circle.
- Balls must be in the goal square at the end of the one minute in order to be counted.

2 Steps

Create:

Now the students will begin the challenge. Once each group is familiar with the rules, pass out the Bits and materials, start a timer with 15 minutes on the clock, and announce that teams may begin building. Either place the timer in a prominent place, or announce the time every five minutes so teams can try to pace themselves appropriately.

Walk around the room and observe how the groups work. These observations will be helpful during the next step when the class discusses their process. **Here are some things to keep your eyes open for:**

- How do the groups start working? Some may begin by planning, while others will dive in and start with hands-on experimentation.
- Do the groups try to execute one single plan or do they experiment with several different approaches to determine what works best?
- How do groups decide what to build or what changes to make?
- How often are their experiments unsuccessful? Do they get discouraged?
- How often are their experiments successful and kept as part of the project?

When the timer goes off, have each group collect the paper balls and prepare for their one-minute challenge.

Play:

Run the one-minute challenges. You can use half of the students as timers and counters, while the other half try to move balls to the goal squares, and then flip the groups. Alternatively, you can have each group go one at time so all students get to watch each invention perform.

Share + Remix:

Now you will hold a discussion to discuss the process. Once all the one-minute challenges are complete, gather the students together. The goal of this discussion is to have the students reflect on each group's design and engineering process so you can draw connections between their methods of working and the littleBits Invention Cycle.

Create four empty columns on a whiteboard (or use four large sheets of paper). Each column will help explain a step of the Invention Cycle, but don't label the columns yet.

In the first column, you will put responses relating to the Create phase. To get students thinking about how they got started, you could ask:

- How did you come up with ideas for what to build?
- How did you decide what to do first?
- Were everyone's designs the same?
- Was your project complete after putting it together the first time? Why not?

In the second column, you will put responses relating to the Play phase. To get students to think about how they used and tested their prototypes, you could ask:

- When was the first time you used what you were working on? Did you ever give it a test? How did it go?
- Why is it important to test what you are working on?
- What could you do with what you learn from testing?
- Did anyone's invention not work the way they hoped when they played with it?
- Was your invention complete after using it the first time? Why not?

In the third column, you will put responses relating to the Remix phase. To get students thinking about how they experimented with and improved their inventions, you could ask:

- Did anyone make changes or improvements to their inventions after they played with them?
- Did anyone try more than one approach/method?
- What was the weirdest idea you tried? What did you learn from it?
- How many different ideas do you think you tried?
- How did you decide which method was the best?
- Why might you want to try more than one way of doing something?

In the fourth column, you will put responses relating to the Share phase. To get students thinking about how to share and why it is important, you could ask:

- After seeing what others have done, do you think you could do it even better now?
- Were there ideas others had you would like to try?
- Did anyone have something to say to you about your invention, maybe some praise or a suggestion?
- Why might you want to share the work you've done with others?
- Why might you want to listen to others share what they've done?

Remix:

Allow students an additional 10 minutes to remix/improve their inventions and run the trial again. Record the second trial scores for each team on the board. Subtract the second trial from the first trial to get each team's "growth score" (how well they improved between each trial).

3 Wrap-Up

Now you will summarize and connect the lesson to the Invention Cycle. Once all the columns are filled, verbally summarize the main ideas in each and draw attention to what they went through as a process. **For example:**

In the first phase they created a bunch of ideas, picked one of them, explored the Bits to see how they could help, and created a prototype of their idea. After summarizing, write **Create** at the top of the first column to highlight these ideas.

Next, they tested their idea by playing with it. They learned which parts of their ideas were on the right track and which parts still needed work. Some of the inventions might not have worked at all, but these "failures" weren't actually bad. They helped the students understand their inventions in a better way. After summarizing, write **Play** at the top of the second column to highlight these ideas.

After playing with and learning about their invention, they made changes and tested those out. Sometimes these changes were small improvements. Others might have pushed aside their old model and tried a totally different approach to the problem. Each time they tried new combinations of Bits and materials, the groups got smarter about the invention, and the inventions got a little better. After summarizing, write **Remix** at the top of the third column to highlight this.

The term **"Remix"** is common in the popular music industry, but kids may not be familiar with it. To clarify, you could explain that "-mix" means to put things together (like mixing ingredients in a cake batter) and "re-" means again (like renewing a library book). So remix means to put things together again.

When the challenge time is up, give students a chance to walk around and see what others have done. They could see the strategies others used, ask questions, and offer comments or suggestions. Sharing helps students feel proud of their work and os a source of fresh new ideas and inspiration. Some may even want to take these new ideas and keep working. After summarizing, write **Share** at the top of the fourth column to highlight this.

Explain to students that they just went through the **littleBits Invention Cycle**. They created a first prototype, played with it to see how it worked, then remixed it with adjustments, improvements, and perhaps tried a few totally different approaches. After a lot of experimentation and comparison, they got to share their results with others, collecting feedback and inspiration.

Lots of designers and engineers have a process they go through when inventing. This is the process the team at littleBits uses when they create new Bits and Kits. The students will also be using it when they complete their littleBits challenges.

To check students' understanding of the Invention Cycle, you could ask them if there are other times in their life when they have done all or part of this process. For example, have they ever made a recipe, but decided to change some of the ingredients? Or perhaps they were building with LEGOs and continued to build and experiment even after following the printed instructions.

At the end of the lesson, students should put away the Bits according to the diagram on the back of the Invention Guide and clean up their materials.

Intro to programming - How does RVR move?

Mission Objective:

In this Mission Objective, RVR must be programmed to navigate around the competition area while avoiding martian terrain areas. Engineers can build a bridge over martian terrain Obstacles. During this challenge, students must build a littleBits invention that RVR interacts with while not being on top of RVR.

Time Required: 45+ minutes

Supplies Needed

- RVR
- Programming Device
- Sphero Edu app

Learning Objectives

- Students will be able to program RVR to move precisely around Obstacles

1 Warm-Up

- Set up an Obstacle course for RVR to navigate through.
- Have students take turns driving through the course - timing them for the fastest speed.
- If students hit an Obstacle or object on the course, they need to restart.

Use the results of this to discuss the following things:

1. The faster you drive RVR, the harder it is to control.
2. The slower you drive, the easier it is to control and not hit objects, but in a competition where speed of completing tasks is important, this isn't the best choice.
3. Programming allows for precision in both movement speed and accuracy.

2 Steps

For the learning session, students will be utilizing the Sphero Edu app and learning the difference of the different types of movement blocks to control RVR.
Roll blocks or speed blocks

3 Wrap-Up

Bring students together to discuss their experiences programming RVR. Possible discussion questions:

Discuss:

- What do you think is the best way to control RVR for the Mission Objectives in this event?
- What other blocks can be used to help control the motion of RVR?

AGENDA #4

Challenge #1 - Learning Session

Mission Objective:

In this Mission Objective, RVR must be programmed to navigate around the competition area while avoiding martian terrain areas. Engineers can build a bridge over martian terrain Obstacles. During this challenge, students must build a littleBits invention that RVR interacts with while not being on top of RVR.

Time Required: 45-60 minutes

Supplies Needed

- RVR
- Programming Device
- Sphero Edu app

Learning Objectives

- Students will be able to control RVR through block programming.
- Students will be able to demonstrate the difference between synchronous and asynchronous movement blocks.

1 Warm-Up

Play a game of “Simon Says” with your students.

- Simon says touch your nose
- Simon says raise your right hand
- Raise your left hand

Try to give commands that will confuse students and prompt them to mess up and miss the command.

2 Steps

Direct students to the activity associated with this meeting agenda.

3 Wrap-Up

If students finish the Sphero Edu activity before the end of your meeting time, it would be a great time to brainstorm a strategy for attempting Mission Objective #1.

Possible discussion questions:

- What is the difference between roll and speed blocks when controlling RVR?
- What option gives the programmer more control?
- What should be the approach that you take for Mission Objective #1 to travel across the Competition Field?

AGENDA #5

Challenge #1 - Working Session

Mission Objective:

In this Mission Objective, RVR must be programmed to navigate around the competition area while avoiding martian terrain areas. Engineers can build a bridge over martian terrain Obstacles. During this challenge, students must build a littleBits invention that RVR interacts with while not being on top of RVR.

Time Required: 45-60 minutes

**Teams may choose to use multiple days to work on this challenge if need be*

Supplies Needed

- RVR
- littleBits RVR Topper Kit Bits
- Camera (possibly a tripod)
- Craft Supplies or Sphero Craft Pack

Learning Objectives

- Students will collaborate with each other to complete the Mission Objective.
- Students will create a program to control RVR.
- Students will create a littleBits circuit that interacts with RVR.

1 Warm-Up

Brainstorm (or continue brainstorming) a strategy for approaching Mission Objective #1.

Things to consider:

Programmer:

- What type of movement blocks should be used for programming the route of RVR?

Engineer

- What type of littleBits invention do you want to create for RVR to interact with?
- Do you want to attempt to build a bridge for bonus points?

Creative

- What type of creative elements can be added to your challenge to add to the rubric score?

2 Steps

After the brainstorming session, give students time to work on their challenge.

3 Wrap-Up

With about 10 minutes left in your meeting, ask students if they are ready to film the final running of their Mission Objective. If they are ready, have them prepare the Competition Field to show off their Mission Objective program. If they are not ready, have them clean up their materials and make a plan for continuing to work, or future filming of their Mission Objective.

Challenge #2 - Learning Session

Mission Objective:

RVR must semi autonomously navigate to the landing zone and using a littleBits invention, clear the debris from the landing zone. RVR cannot touch the debris in the landing zone. All debris must be cleared from the specified landing zone for a successful mission.

Time Required: 45+ minutes

Supplies Needed

- Sphero RVR
- littleBits

Learning Objectives

- Students will be able to build an invention with littleBits to clear a path for RVR.
- Students will be able to program RVR to go to the landing zone and back to the base.

1 Warm-Up

Brainstorm: What would be the best way to clear the landing area?

Possible methods may include, but are not limited to:

- Frontloader invention: lift and drop somewhere else
- Minesweeper: mechanical arm to move things around
- Bulldozer/ Snow plow

2 Steps

Have students navigate to the Sphero Edu app. They will be working on the activity in the Sphero Edu app for learning more about the invention cycle and the programming of RVR with a littleBits invention on top.

3 Wrap-Up

Prepare students for the working session. Spend 5 minutes at the end of the session sketching out a rough plan for the next session.

Challenge #2 - Working Session

Mission Objective:

RVR must semi autonomously navigate to the landing zone and using a littleBits invention, clear the debris from the landing zone. RVR cannot touch the debris in the landing zone. All debris must be cleared from the specified landing zone for a successful mission.

Time Required: 45+ minutes

Supplies Needed

- Sphero RVR
- littleBits
- Craft supplies

Learning Objectives

- Students will be able to build an invention with littleBits to clear a path for RVR.
- Students will be able to build an invention with littleBits to clear a path for RVR.
- Students will be able to program RVR to go to the landing zone and back to the base.

1 Warm-Up

Gather students to discuss the first challenge. Before beginning the work session today, it will be beneficial to review the last working session to see what worked for the students, and to see how things can be improved for this working session. Don't spend too much time on this discussion if the team has a good working groove.

Discuss:

- What went well during the last working session for Challenge #1?
- How did your team handle communication? Problem solving? Debugging?
- What could your team do to improve anything that didn't go as well the last time?

Review the quick brainstorm from the end of last session. What is the plan for each student? Who is going to complete each task?

2 Steps

Work time

Possible Roles and what they could be working on:

Engineers:

- Building a littleBits invention that will clear the space without the debris touching RVR.

Programmers:

- RVR navigating to the landing zone and providing a consistent path for engineers to work with.

Debuggers:

- Helping communicate between the engineers and programmers about the needs of each group.

Creative:

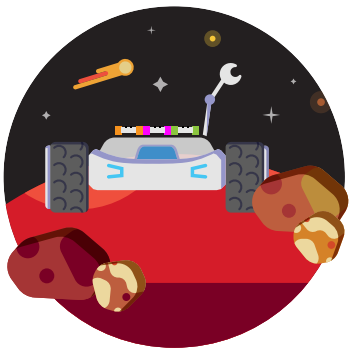
- Thinking of ways to enhance the Competition Field and preparing to film the Mission Objective.

Mission Manager:

- Re-reading all of the rules for the Mission Objective and knowing the evaluation rubric.

3 Wrap-Up

With about 10 minutes left in your meeting, ask students if they are ready to film the final running of their Mission Objective. If they are ready, have them prepare the Competition Field to show off their Mission Objective program. If they are not ready, have them clean up their materials and make a plan for continuing to work, or future filming of their Mission Objective.



AGENDA #8

Challenge #3 - Learning Session

Mission Objective:

RVR must semi autonomously navigate to the landing zone and using a littleBits invention, relocate each of the boxes into the specified cargo areas around the landing zone.

Time Required: 60 minutes

Supplies Needed

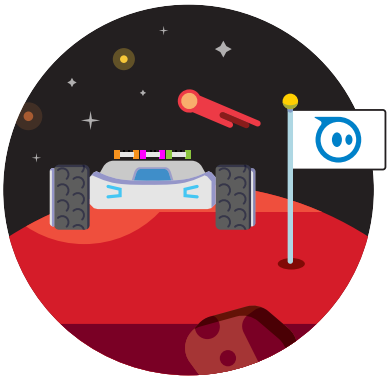
- Sphero RVR
- littleBits RVR Topper Kit (or littleBits kits)

Learning Objectives

- Students will be able to build a lifting mechanism with littleBits.
- Students will be able to control RVR with synchronous and asynchronous blocks.
- Students will be able to program RVR with precision and accuracy.

1 Warm-Up

Have students review their work on the previous challenge. The previous challenge asked students to build a contraption that clears a path for RVR to drive. Ask them how they could think about iterating on that invention to create repeatable motion for moving a box.



2 Steps

Have students navigate to the Sphero Edu app to complete the “Move the Cargo” Activity.

3 Wrap-Up

Have students demonstrate their cargo moving RVR. DIscuss among the students preparing them for the “remix” phase of the invention cycle:

- How could this activity that you completed today help you in being successful in Mission Objective #3?
- Now that you have built your cargo moving robot, what would make it better for completing the Mission Objective?
- When we talk about the remix phase of the Invention Cycle, it’s really important to identify the good/bad and adjust accordingly. Let’s make a plan for how to approach this challenge before our next meeting.

AGENDA #9

Challenge #3 - Working Session

Mission Objective:

RVR must semi autonomously navigate to the landing zone and using a littleBits invention, clear the debris from the landing zone. RVR cannot touch the debris in the landing zone. All debris must be cleared from the specified landing zone for a successful mission.

Time Required: 60 minutes

Supplies Needed

- Sphero RVR
- littleBits RVR Topper Kit
- Craft supplies

Learning Objectives

- Students will be able to build an invention with littleBits to clear a path for RVR.
- Students will be able to program RVR to go to the landing zone and back to the base.

1 Warm-Up

Gather students to discuss the first two challenges. Before beginning the work session today, it will be beneficial to review the last working session to see what worked for the students, and to see how things can be improved for this working session. Don't spend too much time on this discussion if the team has a good working groove.

Discuss:

- What went well during the last working session for Challenge #2?
- How did your team handle communication? Problem solving? Debugging?
- What could your team do to improve anything that didn't go as well the last time?

Review the quick brainstorm from the end of last session. What is the plan for each student? Who is going to complete each task?

2 Steps

Break students into 2 different working groups, an engineering team and a programming team.

- The engineering team will be coming up with a solution for moving objects with littleBits.
- The programming team will be working on a solution for navigating RVR in the Competition Field as outlined in the Mission Objective.
- The other roles can be divided into the same groups above, even if they have different tasks to work on.

Possible Roles and what they could be working on:

Engineers:

- Building a push/pull/drag type of invention with littleBits.

Programmers:

- Creating a consistent path for RVR to navigate to the landing zone.

Debuggers:

- Working to communicate between the engineers and programmers about the needs of each.
- Helping with solving problems in programs or inventions.

Creative:

- Working on adding creative flair to the Competition Field.
- Planning out the filming of the Mission Objective.

Mission Manager:

- Coordinating all of the roles.
- Stepping into help each role when other students need help.

3 Wrap-Up

With about 10 minutes left in your meeting, ask students if they are ready to film the final running of their Mission Objective. If they are ready, have them prepare the Competition Field to show off their Mission Objective program. If they are not ready, have them clean up their materials and make a plan for continuing to work, or future filming of their Mission Objective.

AGENDA #10

Challenge #4 - Working Session

Mission Objective:

Your martian friend has been stranded on a mission, and you have to go rescue her. Program RVR to go to the correct location and invent a way to bring your friend back to the base.

Time Required: 45+ minutes

Supplies Needed	Learning Objectives
• Sphero RVR • littleBits	• Students will be able to program RVR to navigate on the Competition Field in line with the Mission Objectives.

1 Warm-Up

Because this challenge has many elements that are similar to the previous challenge, students can jump into this challenge without having to learn something new.

Gather students to discuss the first two challenges. Before beginning the work session today, it will be beneficial to review the last working session to see what worked for the students, and to see how things can be improved for this working session. Don't spend too much time on this discussion if the team has a good working groove.

Discuss:

- What went well during the last working session for the previous challenges?
- How did your team handle communication? Problem solving? Debugging?
- What could your team do to improve anything that didn't go as well the last time?

Review the quick brainstorm from the end of last session. What is the plan for each student? Who is going to complete each task?

2 Steps

Break students into 2 different working groups, an engineering team and a programming team.

- The engineering team will be coming up with a solution for moving objects with littleBits.

- The programming team will be working on a solution for navigating RVR in the Competition Field as outlined in the Mission Objective.

Possible Roles and what they could be working on:

Engineers:

- Building a littleBits invention to sit on top of RVR to be used in completing the Mission Objective.

Programmers:

- Programming a consistent path for RVR to navigate to the martian areas and return to base.

Debuggers:

- Working with engineers and programmers to bridge any needs between the two groups.

Creative:

- How can you use craft supplies to create a martian friend?

Mission Manager:

- Knowing the evaluation rubric and rules for the mission.
- Supporting each and every team member that may need help.

3 Wrap-Up

With about 10 minutes left in your meeting, ask students if they are ready to film the final running of their Mission Objective. If they are ready, have them prepare the Competition Field to show off their Mission Objective program. If they are not ready, have them clean up their materials and make a plan for continuing to work, or future filming of their Mission Objective.

Challenge #5 - Learning Session

Mission Objective:

Teams are tasked to come up with a computational model or simulation of a scenario / problem for using the sensors of RVR and interacting with a littleBits invention.

Time Required: 45-60 minutes

Supplies Needed

- Sphero RVR
- littleBits
- Craft Supplies

Learning Objectives

- Students will be able to utilize data from RVR in their code.
- Students will be able to build a working circuit with littleBits.

1 Warm-Up

Show a blow up view of RVR's components. Ask students what sensors they see, and what they actually do?

Use the following explanations for reference:

- **IMU (Inertial Measurement Unit):** measures the accelerometer and gyroscope data from the RVR in 3 axes (X, Y, & Z)
- **Color Sensor:** evaluates the color (or light) it is sensing in 4 different sensors Red, Green, and Blue.
- **Ambient Light Sensor:** Measures the light intensity of the environment and returns the value in Lux (luminosity).
- **Infrared:** broadcasts/receives infrared signals for robot to robot communication.

2 Steps

Direct students to the Sphero Edu app to complete the Mars Mission Sensor Data activity.

3 Wrap-Up

Have students share out what they learned about the sensors in the activity. Have them include how the sensor works and what it could be used for (in real life, or in a creative way to represent something on Mars).

Challenge #5 - Working Session

Mission Objective:

Teams are tasked to come up with a computational model or simulation of a scenario / problem for using the sensors of RVR and interacting with a littleBits invention.

Time Required: 45+ minutes

Supplies Needed

- Sphero RVR
- littleBits
- Craft Supplies

Learning Objectives

- Students will be able to come up with a simulation for RVR and littleBits to complete.

1 Warm-Up

Ask students if they have seen any movies or shows that deal with spaceflight, Apollo missions, or even just realistic space travel? (The Martian, Apollo 13, Lost in Space, etc.)

If they have seen these, ask the following questions:

- Does everything always go according to plan? Why or why not?
- What types of science or scientific experiments is portrayed in these films/shows?

If they haven't seen any of the following, share the following prompt:

- In a movie like Apollo 13, astronauts have to come up with a solution for how to fix a malfunction with an oxygen tank, or another movie, The Martian, Mark Watney had to figure out how to engineer his way to surviving being the only person on Mars. Regardless of the movie or scenario, the machines that we have created for space travel allows us to conduct many different experiments.

Now have students think about what experiments they would want to conduct on Mars if they had the choice.

This challenge is designed for you to come up with a creative simulation for how RVR and a littleBits invention could be used on the surface of Mars. You should think about the sensors that you could use, the inventions you can engineer with littleBits and bringing those together in a creative way to tell a story.

2 Steps

Break students into 2 different working groups, an engineering team and a programming team.

- The engineering team will be coming up with a solution for moving objects with littleBits.
- The programming team will be working on a solution for navigating RVR in the Competition Field as outlined in the Mission Objective.

Possible Roles and what they could be working on:

Programmers:

- What will RVR be doing during the mission?
- What type of movement blocks do you plan on using?
- What sensors are needed (littleBits or RVR, both?)

Engineers:

- What littleBits inventions need to be made to add to the story and objective of your sensing mission?

Debuggers:

- How do you make sure that the sensors are reporting the correct information?

Creative:

- What creative elements can be placed in the Competition Field to better represent the overall mission?
- What do you need to film in order to get the whole mission filmed?

Mission Manager:

- Do all of the pieces fit together?
- Does the storyline make sense?
- Is this mission something that seems plausible in real life?

3 Wrap-Up

With about 10 minutes left in your meeting, ask students if they are ready to film the final running of their Mission Objective. If they are ready, have them prepare the Competition Field to show off their Mission Objective program. If they are not ready, have them clean up their materials and make a plan for continuing to work, or future filming of their Mission Objective.

AGENDA #13

Get it all submitted!

Time Required: 1+ hour

Learning Objectives

- Students will put together an engineering design packet.
- Students will put together a video for submission

1 Warm-Up

This is a great time to throw a party! You've done it all, but it's important to make sure that you have everything completed correctly and ready to submit.

2 Steps

Review the submission guidelines and rubrics to ensure that everything is completed as required.

Reminders:

- Recordings of the Mission Objectives being completed should not be edited, but they should be combined into one video file.
- Code and Engineering Design packet needs to include an infographic and a page showcasing each littleBits invention.
- A registered coach should be in charge of collecting these files and submitting them to robotevents.com in the correct event that you are registered for.

2 Wrap-Up

Find a way to celebrate with your students:

- Print up certificates of completion for the RVR+LB Mission Mars event.
- Create a t-shirt as a team to highlight your accomplishments.
- Invite the school administrators and/or parents to a viewing party to showcase all of the Mission Objectives (or show the video and share the Code and Engineering Design Packet).