CLEAN ENERGY BRIGHT FUTURES
A Program of BEF

LESSON PLAN

Solar SPRK+

Lesson 5: Chariot Engineering Design

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DESCRIPTION
Students will

GRADE LEVEL(S)
6, 7, 8

SUBJECT AREA(S)
Engineering design; Mars rover

ACTIVITY LENGTH
2 hours

LEARNING GOAL(S)

1. Students will identify possible design solutions to have a Sphero SPRK+ pull solar panels as a portable power source.
2. Students will work in groups to determine the best possible designs and construct and test these designs with their team.
3. Students will determine the strengths and weaknesses of each design and incorporate these findings into further construction phases.

STANDARDS REMINDERS

- Make sure that students are determining the criteria for success and constraints in their groups and note them within their engineering notebooks.
- Additionally, make sure they are consistently tracking different design aspects that make their chariots successful or hold it back from success. Use this as an opportunity to discuss variables with student teams and how they can track the effects of modifying different variables in their design.

CONTENT BACKGROUND

STUDENT BACKGROUND

Students participating in this lesson should be familiar with the engineering design process.

EDUCATOR BACKGROUND

Educators leading this lesson should be familiar with electromagnetic induction and the engineering design process (see unit plan for details).

REQUIRED MATERIALS

HANDOUTS/PAPER MATERIALS

- N/A

CLASSROOM MATERIALS

- Tape to set up simple track for chariot pulling

ACTIVITY MATERIALS (GROUPS OF 3-4)

- Building "blocks" with wheels, such as K'NEX and/or Legos
- Scrap cardboard

- Sphero SPRK+
- (3+) 2 Volt x 500 mA photovoltaic modules (solar panels)

LESSON PROGRESSION

PLANNING AND PREP

Ensuring that you have all materials on hand and readily accessible for students to design their chariots. If necessary, you can dictate materials for specific groups.

LESSON SEQUENCE

INTRO

Figure 1 Engineering Adventures Engineering Design Process by EiE (eie.org)

- In this section, students will be creating a chariot that will carry the solar modules required to charge their SPRK+.
- Having a background in the engineering design process is key for students here, as they will undoubtedly be engaging in a large amount of planning and redesign throughout the process.
- Figure 1 shows a diagram of the engineering design cycle used to frame this lesson sequence, from Engineering is Elementary. It is important to realize that some of these steps happen in repetition, and often times move back and forth between various steps (e.g. redesign requiring a step back to imagine/plan/test before determining a better or worse design).

ENGINEERING DESIGN (IDENTIFY, INVESTIGATE)

- Prior to beginning the planning process, introduce the challenge to students. Essentially, they will need to design a chariot that will assist in carrying their solar modules to a charging station. This simulates the need for portable energy sources that never run out in a space travel situation. For this stage of the project, they can simply carry their modules in a straight line.
- From this challenge, they can begin to identify a number of factors that will play into their design, i.e. loadbearing, the ability to make turns, etc. Have students note these characteristics they will have to take into account in an engineering notebook.
- The constraints provided to students will be determined by the maze in the next section of the unit and supplies available to the teacher.

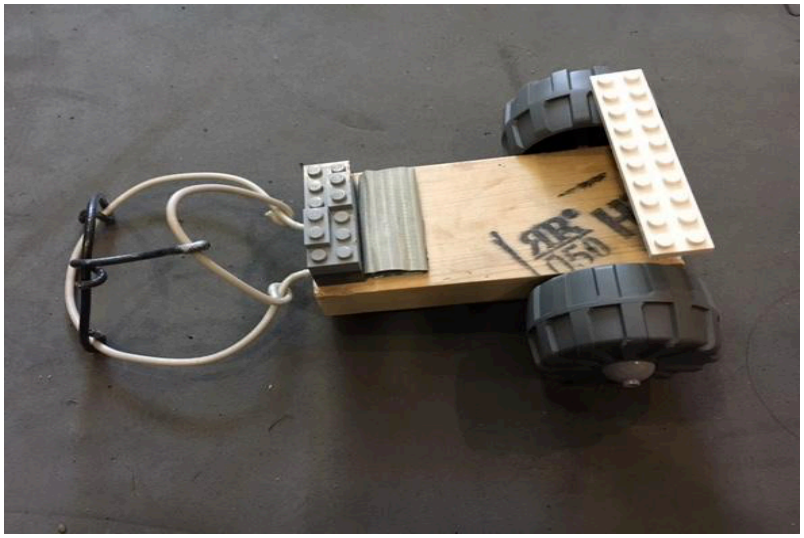

Figure 2. Student Chariot A

ENGINEERING DESIGN (IMAGINE, PLAN)

- In an engineering notebook, have students use the supplies available to them to draw four different modules individually of potential chariots they can build to carry their modules.
- Working in groups, have them narrow down their individual designs to one group design to test first.

ENGINEERING DESIGN (CREATE, TEST, IMPROVE, COMMUNICATE)

- Again, make sure students only test their SPRK+ chariot designs in a straight line, perhaps having them code the SPRK+ to move 10 ft straight to a charging station. You could additionally have students construct the circuit upon arrival.
- After their first trial, have students take notes on the successes and failures of their initial test, writing these in an engineering notebook. They will use these notes to help in the improvement of their later design.
- With each additional trial, have students note the changes they made each time in order to track successful and unsuccessful iterations of their design.
- If some students finish quickly, set up a situation with perhaps one turn at the end in order for them to test how their chariot can handle a single turn as a sort of scaffolding technique before the final maze challenge.

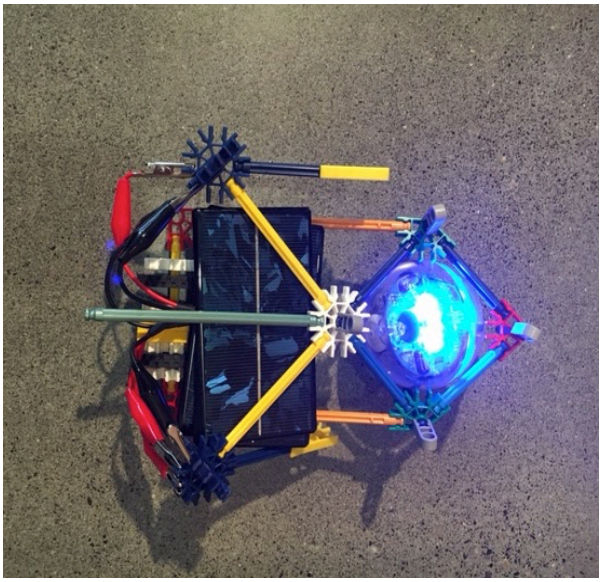

Figure 3. Student Chariot B (with Sphero SPRK+)

- As a class, have students note how they can continue to improve their design and note supplies that they would like to have for these future designs. This is a way to open up the project in terms of creativity and diversity in materials should you or your students have the ability to add on to the supply list.

ASSESSMENT AND EXTENSIONS

FORMATIVE ASSESSMENT

Teacher should be asking lots of questions to facilitate student problem-solving and reminding students to use the Engineering Design Process. There is no formal formative assessment for this section.

SUMMATIVE ASSESSMENT

N/A

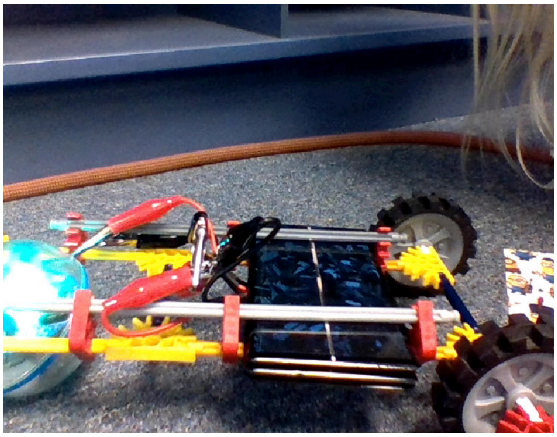

Figure 4. Student Chariot C (with Sphero SPRK+)