

Friction Road Racers

SUBJECT

Physical Science

GRADE LEVEL

8

DURATION

60-90 min

TEACHER DIFFICULTY

Intermediate

STUDENT DIFFICULTY

Intermediate

DESCRIPTION

In this lesson, students will experience the force of friction as they code a Sphero to drive through a maze that contains surfaces of varying degrees of friction.

➤ CONTENT STANDARDS

- PS.8 – The student will investigate and understand that work, force, and motion are related.

➤ COMPUTER SCIENCE STANDARDS (2024)

- 8.AP.1 – The student will apply computational thinking to construct programs to accomplish a task as a means of creative expression or scientific exploration.
- 8.AP.2 - The student will plan and implement algorithms that include sequencing, loops, variables, user input, conditional control structures, functions, and various data types.
- 8.AP.3 - The student will use the iterative design process to create, test, and debug programs using a block-based or text-based programming language.

LESSON OBJECTIVES

1. Students will recognize the direction of the force of friction. (PS.8)
2. Students will explain why force must be exerted continually to keep an object sliding across a carpeted surface. (PS.8)
3. Students will create programs which specify the order in which instructions are executed within a block-based program. (CS8.1)
4. Student will refine a program based on results from their test cases. (CS8.2)
5. Students will communicate effectively to solve a problem. (CS8.3)

MATERIALS

- 1 friction maze per group
- 1 iPad per group (with Sphero application installed)
- 1 Sphero per group

COMPUTER SCIENCE VOCABULARY

Term	Definition
Debugging	Systematically finding the cause of an error in a program and fixing it.
Command	An instruction telling a computer program to do something.

ADVANCE PREPARATION

Materials

- A variety of surface materials, such as artificial grass, carpet squares, tiles, foam flooring, corkboard, etc.
- 1 piece of foam board for every 4 students
- Super glue

Maze Creation

Cut the variety of surface materials into strips approximately 4-5 inches wide. Then, attach the various pieces to a piece of foam board in a variety of ways to create a maze with a starting point and ending point. Make sure to create a variety of difficulties to allow for differentiation between student skill levels.

LESSON STRUCTURE

Introduction

This activity is to be done after students have learned the basics of how friction impacts the work done on an object. To review before this activity, students can view (optional) the Magic School Bus Episode “Plays Ball.” This episode is 25 minutes long and can be found on eMediaVA, which every Virginia public school teacher has an account to access for free.

Instruction

1. Explain to students that today they will experience the effects that different amounts of friction can have on completing everyday tasks. Begin by putting students in groups of 3-4. Give each group one maze board, one iPad, and one Sphero Bot.
2. Review the computer science vocabulary that students will be applying in today’s lesson, including “command” and “debugging.” Explain to students that they will be using a trial-and-error method of coding to help them complete a task today. Show students a brief video on how to use coding blocks to program their Sphero Bot to complete a maze. YouTube has several good resources to help you with this.
3. Challenge students to move their Sphero Bot through their provided maze. Remind students that the amount of friction on each material will differ, so as they write commands for their Sphero Bot, they may have to debug their program by changing the speed or length of time the Bot moves over each surface.



Closure

As a formative assessment for this activity, provide students with the following prompt:

How does the surface of an object impact the amount of friction present?
What can be done to overcome a surface with increased friction?

Instruct students to write their responses to the prompt and turn them in so you can establish what the students learned about friction, and what misconceptions they may still have after the activity. Strong reflections from students may include how softer and rougher materials contain more friction than smoother and harder materials. It may also include how friction can be overcome by either increasing the speed of the object moving, or extending the time the object has to move over the material in order to conquer the friction.

OPPORTUNITIES FOR DIFFERENTIATION

Enrichment

For students who may complete the challenge quickly, provide the students with some Lego bricks or various consumable supplies, such as cardboard, straws, string, etc., and instruct them to build a chariot that their Sphero can pull through the maze. Adding this element to the challenge will again change the force of friction and require students to again reevaluate their code and adjust it to be successful.

Remediation

If students are struggling with completing their maze, you can try moving the finish line after only 2-3 surfaces by using a sticky note to mark the new finish. You can also trade out their maze for one with fewer turns to help the students become more successful.