Marble Roller Coasters

Adaptation for Remote Instruction

Introduction

This investigation asks students to design a marble roller coaster. The roller coaster uses marbles in place of cars, and pipe insulation segments, cut in half lengthwise, as roller coaster tracks. Because all schools may not be able to provide all students with the supplies to make their own roller coaster models during remote instruction, an alternate instructional strategy is provided here.

NGSS

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

Materials

Marble Roller Coasters investigation - one copy per student

1-4 pre-recorded videos of marble roller coaster designs that were unsuccessful (that is, either the marble does not complete the entire track or the marble finishes the track but does not land in the cup).

Scale drawing of the marble roller coaster in each of the pre-recorded videos

For teacher demonstration:

- 3 3-ft long ½ pipe insulations
- ~3ft masking tape
- 1 cup to catch marble
- 1 marble
- 1 steel ball of a different weight (optional)
- 1 stopwatch (a cell phone works well for this)
Preparations prior to the lesson:

Depending on your class size, record 1 - 4 videos of marble roller coasters that are unsuccessful in the design challenge. Prepare a scale drawing of the marble roller coaster that appears in each video. Form groups of 3 or 4 students who will work remotely as a team to analyze and critique the roller coaster shown in one of the videos. The student teams will then develop a model of a roller coaster that will correct the design flaw(s) in the coaster shown in the video and illustrated in the drawing. During a virtual class session, the teacher will build and test the roller coasters using the student-designed models.

The Task:

- Assign one of the sample videos to each student team (Teams may consist of 2-4 students who will collaborate synchronously or asynchronously).

- Instruct students to view the video and analyze the scale drawing to identify the design flaws in the marble roller coaster. Encourage students to view the video multiple times as needed. Ask students to brainstorm potential solutions to the problems they identified. (Jamboard may be used to record the brainstorming session.)

- Instruct the student teams to develop a revised model for the roller coaster that would correct the problem(s) they have identified. Provide guidelines for students’ models. These guidelines might include requirements such as:
  
  o an explanation of the problem with the original roller coaster that cites evidence from the video and explains their reasoning
  
  o a consensus model that includes a description of the design changes they recommend
  
  o an evidence-based explanation of how the recommended revisions would correct the original roller coaster’s design problem(s)

- Collect students’ models and build the roller coasters according to their instructions. Conduct the testing of the revised roller coasters during a virtual class meeting.

Assessment:

Several aspects of the investigation may be used for formative assessment, including:

- Brainstorming session conducted by student groups as they analyze the roller coasters in their videos
- Student collaboration on developing a consensus model of the redesigned roller coaster
- Students’ use of science concepts to support their redesign, as shown in the model they submit