



County Implementation Award Program (CIAP) Math and Science Lesson

Unit Title: Force and Motion
Lesson Title: Marble Run
Author: Maria Solis
Grade Level: 3 rd
Time Frame: 5 days
Targeted Standard(s): NGSS 3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. ELA W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1), (3-PS2-2) SL.3.3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. (3-PS2-3) Mathematics MP.2 Reason abstractly and quantitatively. (3-PS2-1) MP.5 Use appropriate tools strategically. (3-PS2-1) MD. 4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.
Short Description of Targeted Phenomenon: Show students videos of a rollercoaster. Show this video (start at 3:00) or this video clip . Equal and unequal forces have different effects on an object. As an object gets higher in the air, gravity can pull it down a greater distance.
Three Dimensions of NGSS
Science & Engineering Practice/s (SEP): <ul style="list-style-type: none">Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials

considered (3-PS2-1)

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test to design a solution (3-PS2-2)

Crosscutting Concept/s (CCC): Patterns, Cause and Effect

- Patterns of change can be used to make predictions (3-PS2-2)
- Cause and effect relationships are routinely identified (3-PS2-1)

Disciplinary Core Idea/s (DCI):

- PS2.A: Forces and Motion: Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)
- PS2.B: Types of Interactions: Objects in contact exert forces on each other. (3-PS2-1)

Language Supports:

slide deck or [anchor chart](#) with visual vocabulary (incline, force, acceleration, momentum, inertia, centripetal force, energy, motion)

*Recreating the anchor chart on to chart paper works best so the students have a visual before starting the project.

Materials Needed:

marbles, toilet paper or paper towel rolls, cardstock, masking tape, scissors, ruler, and timer

Objective(s):

1. Students will collaboratively construct a marble run with a minimum of two turns and one incline that will allow a marble to travel the entire run in less than 30 secs.
2. Students will be able to demonstrate the knowledge of force and motion concepts in a written summary or video.

How Math and Science concepts/skills/practices were integrated in this lesson:

Math

- MP.2 **Reason** abstractly and quantitatively.
- MP.5 **Use** appropriate tools strategically.

- MD. 4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.

Science

- 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- 3-PS2-2. Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.

Possible Challenges /Misconceptions:

Students lack understanding of what a turn or incline is. Students could misconstrue the reason the marble is able to move through. Students are unable to cooperate and respect each other’s input.

Formative Assessment:

Teacher observation of collaboration between students, incorporation of turns and inclines in run, students performing tasks assigned to their role, evaluate construction and success of marble run.

Lesson Opening

Teacher Actions

Activate prior knowledge and student interest- teacher presents an interesting situation, phenomenon, or dilemma that helps students connect to the content.
Show this [video](#) (start at 3:00) or this [video clip](#).
Document student ideas.

Student Actions

View video clip and discuss what enable the roller coaster to move through turns and inclines. Share out ideas.

Lesson Introduction

Teacher Actions

Getting students ready - teacher introduces the task and makes sure students understand *what* they are trying to accomplish, but not *how* they are to do it.
Pose questions on run design.
Put students in collaborative groups. Show track construction videos.
Questions and ideas can be found [here](#).
Clarify questions and misconceptions.
[Paper Tracks](#)
[Loops and Corkscrews](#)
[Funnels](#)
[Supports](#)
Provide students with parameters (number of turns, number of inclines, length of incline, time of run, conclusions) of the investigation.

Student Actions

In collaborative group, discuss plans for marble run construction. Decide on roles and duties for each team member.
Gather materials.

Body of Lesson

<p>Teacher Actions Teacher observes students, monitors their progress, and provides clarification as necessary. Circulate room, observe groups, ask questions of students to check for understanding.</p>	<p>Student Actions Work together to construct a marble run that meets the parameters. Test run, problem solve collaboratively and make modifications to their tracks in order to successfully run the marble.</p>
<p>Lesson Closure</p>	
<p>Teacher Actions Teacher facilitates group discussion, helps students share their work/progress, helps students make connections, and ensures that big ideas are brought forward. Have students share their constructions. What worked, what didn't? What conclusions did your group make?</p>	<p>Student Actions Discuss findings within their group and share with class. Write a summary of findings in either a notebook or using technology or create a video explanation using Adobe Spark.</p>
<p>Summative Assessment: Video/Written Presentation Rubric</p>	
<p>Other Teaching Resources: Ideas to share: What is Inertia How Does a Train Work? 5 Fun Physics Phenomena</p>	
<p>Lab Safety:</p>	
<p>Extensions (if any): Compare data (i.e. height of incline) across the whole class.</p>	