Marble Runs Experiment

Acceleration, Deceleration, and Velocity

Grade: Middle School & Higher **Prep Time:** 10 minutes

Lesson Time: 2 Class Periods

Students will analyze each piece of the marble run to determine which piece will work for each task. Each run will be timed to help them understand the physics concepts of Acceleration, Deceleration, and Velocity. Marble Genius marble run toy pieces will be used to construct the marble run. Students will be asked to observe which pieces enable the marble to achieve each task and adjust their marble runs to meet their goals. At the end of the experiment, each student will write a short essay of what was learned.

STEM CORE & COMPONENT QUESTIONS	INSTRUCTIONAL OBJECTIVES
UNDERSTANDING ACCELERATION, DECELERATION, AND VELOCITY AND HOW DOES IT RELATE TO PHYSICS?	Students will be able…**to model** a series of Marble Runs using basic building techniques to understand how different pieces and setups accelerate the speed of the marble.

1.0 Materials

Required Materials

Please Supply:

For marble run building (per group of students)

- **Marble Genius Starter Set, Super Set or Extreme Set pieces:**
  - **20 tubes (minimum)**
  - **3 bases (minimum)**
  - **5 different action pieces (wheel, ladder, squiggly, etc.)**
  - **1 top entry piece**

For observing, designing, and capturing results (per group of students)

- **Paper and pencil**
- **Colored pencil (green, yellow, purple, red, blue)**
- **2 metric rulers**
- **Wall clock/stop watch/timing device (seconds - ideally hundredths)**

Please Print:

From Student Guide Below:

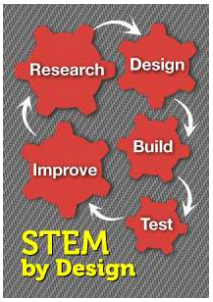
(A): Factors Impacting Acceleration, Deceleration, & Velocity - 1 Per Student

(B): Time Sheet - 1 Per Group

2.0 Teacher Vocabulary

Marble Run	Typically made of wood or plastic and feature small, interlocking pieces that can generate a large number of track configurations for a marble to run down. More complicated add-ons, such as jumps, loops, trampolines, xylophone ramps, and electronic triggers are also typical with more complex sets. A type of Rube Goldberg Machine.
Acceleration	Increase of speed or velocity.
Deceleration	Decrease of speed or velocity.
Velocity	Speed
Slope	Incline or slant, especially downward or upward
Prediction	A declaration about what will happen based on reason and
Design	A plan or drawing produced to show the look and function or workings of a building, garment, or other object before it is built or made
Impediment	A hindrance or obstruction in doing something
Experiment	A scientific procedure undertaken to make a discovery, test a hypothesis, or demonstrate a known fact.
STEM by Design	Research, Design, Build, Test, Improve

3.0 Procedures



The purpose of this lesson is to use the Stem by Design process to help students learn about ***Acceleration, Deceleration, and Velocity.*** In addition, to see if the order of the pieces impacts the time it takes for the marble to make it to the bottom.

Day 1

Step 1: Engage – The first part of the lesson will highlight basic definitions and introduce the lesson.

Step 2: Explore – The students (in groups of 5-6) will spend the remaining time to explore what the different pieces do. Assemble the pieces to make different marble runs. You may want to take notes on the different pieces. (Use Student Guide)

Step 3: Explain – While the students are still in groups, take 5 minutes to remind the students of several important concepts (slope, impediment, etc.) and answer any questions they have before the students finish.

Step 4: Evaluate/Review – Once students return to their desks, take time to review the concepts and ask them what they learned and any observations that they have.

Day 2

Experiment: You will be given a task and a time limit. All groups will do the final timed run at the same time. (Use the Time Sheets)

Task #1: Construct the fastest marble run possible.

-You may use as many or as few pieces as you choose.

-You will have 6 minutes to create your run.

-The marble run must be free standing. You cannot be holding on to it.

Task #2: Construct the slowest marble run possible.

-You may use as many or as few pieces as you choose.

-You will have 6 minutes to create your run.

-The marble run must be free standing. You cannot be holding on to it.

Task #3: Construct the most active marble run possible.

-You may use as many or as few pieces as you choose.

-You will have 6 minutes to create your run.

-The marble run must be free standing. You cannot be holding on to it.

Evaluate: You need to write a reflection essay on one of your marble runs. Not all of your marble runs were perfect, but you will be able to write all three paragraphs. Make sure that your essay focuses on only one marble run.

Note: In the first paragraph, you need to describe your marble run. The second paragraph should describe what worked well in your marble run. The third paragraph will describe how you could have improved your marble run.

Name_____

Notes On Your Exploration of Marble Run

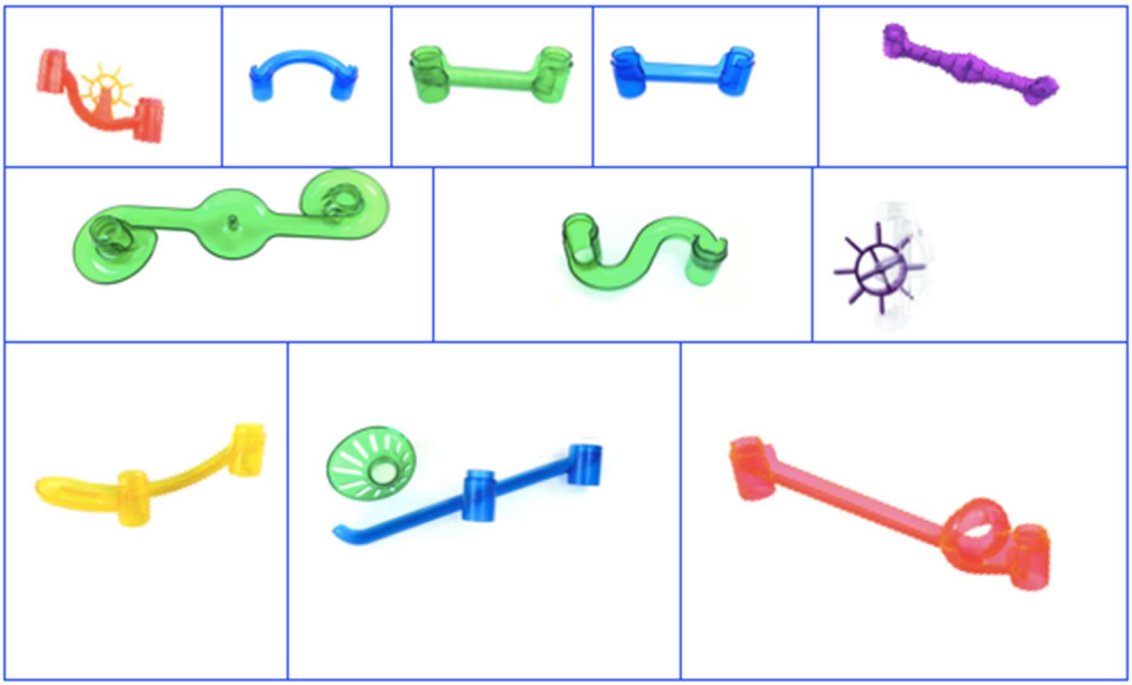
Make notes how each piece will affect your marble run. (Cross out any pieces you don't have)

F = Fast Acceleration

M = Medium Acceleration

S = Slow Acceleration

i = Impediment



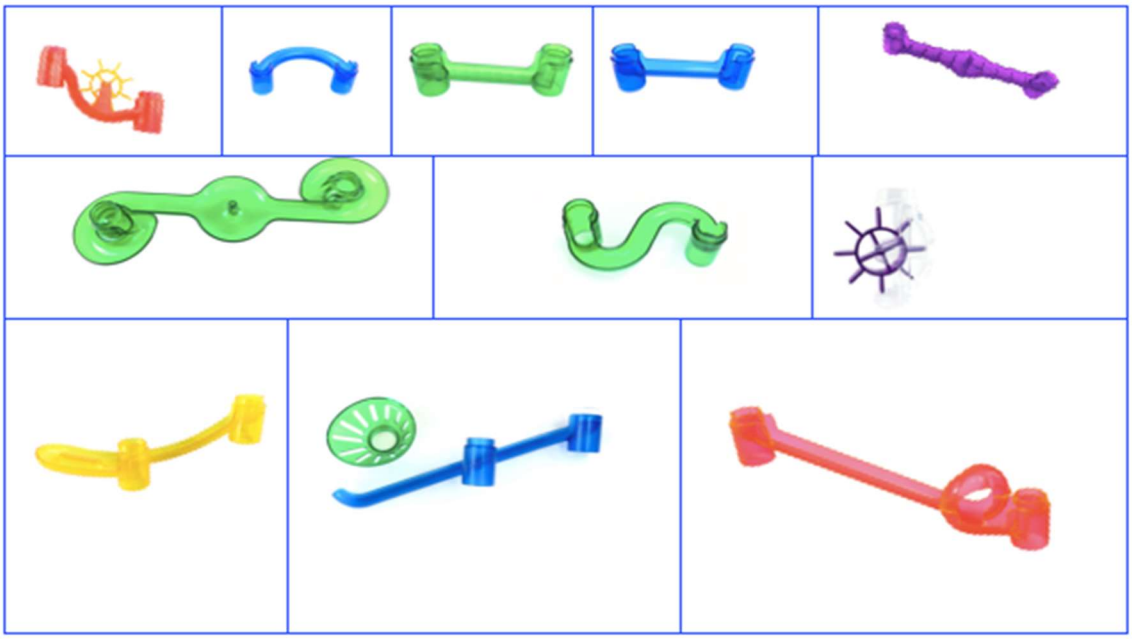
Time Sheet

Names: _____

1.) **Cross out the pieces below that you don't have.**

2.) **Refer to your short descriptions for how the part will affect the marble run**

3.) **Create a marble run with all the pieces you have.**



Task #1: Construct the fastest marble run possible

Time (seconds)	List of parts of marble run used

Task #2: Construct the slowest marble run possible

Time (seconds)	List of parts of marble run used

Task #3: Construct the most active marble run possible

Time (seconds)	List of parts of marble run used