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| **Standard(s) addressed:** |
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| **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.** |
| **MS-PS2-2.** | **Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.** |
| **MS-PS2-4.** | **Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** |

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| **Targets:** (What will students know and be able to do as a result of this lesson?) |
| * **Build and create their own roller coaster using the principles of physics**
* **Discuss and use potential & kinetic energy, friction, mass, and gravity to consider motion and forces and the impact each has on one another.**
* **Participate in the engineering design cycle**
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| **Assessment:** (How will you and your students know if they have successfully met the target?) |
|  **Students will be assessed throughout the building process of their roller coaster. Teachers and aides will circulate and be asking questions to gauge the level of understanding by individual students. Students will have met the target if they have completed their roller coaster and are able to explain orally, written, or on the final presentation (rubric) if they understand potential and kinetic energy and the effects of friction, mass, velocity, and gravity.** |

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| **Instructional Activities:** (In what learning experiences will students engage? Consider higher order thinking, multiple intelligences, multimodal, and/or multimedia input.) |
| 1. **Divide class into groups based on academic and/or behavior.**
2. **Each group will receive a scoring rubric. There will be design principles necessary to be the most successful roller coaster in the competition. The goal will be to get each of the various types of marbles down their roller coaster the fastest.**
3. **Groups will design, name, and draw their designs for their roller coaster.**
4. **Students should build their design in under 15 minutes and practice using the marbles.**
5. **Teachers and aides should be observing and checking their designs, asking what is going well and what changes might need to be made.**
6. **Students will then time the various marbles on their roller coaster and fill out a worksheet. Students will also need to plan and prepare for their final presentation.**
7. **Have each group present its roller coaster model to the class. Use the scoring rubric to evaluate the roller coaster model designs. Discuss the results as a class.**
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| **Resources/Materials Required:** |
| * **2-meter (6 foot) long foam tube (1/2" pipe insulation) cut in half lengthwise**
* **glass marble**
* **wooden marble**
* **steel marble**
* **paper or plastic cup**
* **roll of masking tape**
* **set of markers, crayons or pencils**
* **blank sheet of paper**
* **stopwatch**
* **Worksheet**
* **Rubric**
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| **Student Engagement:** How will you get and hold student attention? |
| **Lesson Hook: Teacher will show fun videos of roller coasters and start a discussion about what the engineers of roller coasters need to consider when building and designing one.****Students will continue to be engaged throughout the lesson by the interactive nature of designing a roller coaster, and it will meet all learners through a variety of means. There will be oral discussion, drawing and creativity, written worksheets, visual and kinesthetic experiences.** |

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| **Differentiation:**  (How will you adjust the lesson to appropriately challenge ALL students?) |
| **Students will be grouped prior to the lesson by the teacher based on ability level and behavior issues.****Differentiation will occur through the natural engineering design process that incorporate a variety of learning styles. Based on the variety of students, some will be working in groups while others may work individually based on learning or behavioral needs. Some students will be focused on the basic principles such as energy, gravity, friction, and the design process. Higher level students can be challenged by including equation components and further development of their design by including information regarding the law of conservation of energy and looking at loops and the concept of critical velocity. Some students will require more assistance from teachers and aides when considering their design and making improvements while others may work more independently.** |

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| **IEP/504 Modifications/Accommodations:** (What curriculum modifications and/or classroom accommodations will you make for Students with Disabilities in your class? Be as specific as possible.) |
| **-Hear instructions orally and be given a written list of instructions****-Further directives, repetition, and assistance from teacher/aides****-Give responses in an oral/written/recorded video form****-Work in a different setting (fewer distractions)****-Take more time to complete the task/frequent breaks****-Use an alarm to help with time management****-Answer fewer/different questions****-Individual redirection**  |

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| **Suggestions for Consideration and Reflection:** |
| What went well?What did you learn?What adjustments will you make moving forward?What did your assessment results indicate?Was this lesson rigorous enough to engage all students? Explain.Were the modifications/accommodations sufficient to facilitate meaningful participation for challenged students?Would you be willing to share this lesson with colleagues? If no, why not? |
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