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| **Lesson Title:**  Roller Coaster Rally | |  |
| **Grade Level:** 4th | **Quarter:**  2nd |
| **Standards:**  Science  **S4P3.** Students will demonstrate the relationship between the application of a force and the resulting change in position and motion on an object.  b. Using different size objects, observe how force affects speed and motion.  c. Explain what happens to the speed or direction of an object when a greater force than the initial one is applied.  d. Demonstrate the effect of gravitational force on the motion of an object.  Habits of Mind  **CS3-**Students will use tools and instruments for observing, measuring, and manipulating objects in scientific activities.  Engineering skills | | |
| **Lesson Essential Question:**   * How can I demonstrate the relationship between the application of a force and the resulting change in position and motion on an object? | **Vocabulary:**    Force  Motion  Speed  Gravitational Force | |
| **Lesson Materials:**  • ¾ inch pipe insulation  • Pool noodles  • Paper towel rolls  • Wrapping paper rolls  • Lamination rolls  • newspaper  • 1 roll of masking tape  • 2 Chairs  • 2 boxes  • small marbles  • large marbles  • 1 stopwatch for timing trials of marbles | **Lesson Assessment:**  Student Journal  Teacher Observations | |
| **STEM Challenge Overview:**  Students will design and build a roller coaster to test different size marbles to explain how force affects speed and motion. | | |
| **Teacher Background:**  In our science unit on force and motion, we have been studying how both can be affected by gravity. We have also studied different types of energy,:potential and kinetic and their relationships to movement. | | |
| **INSTRUCTION** | | |
| 1. **Ask/Engage (day 1)** | | |
| Start out the lessons by students sharing their experiences of riding roller coasters. What kind of coaster was it? Where was it? Did it have loops and hills? How fast do you think it went?  On a smart board/Promethean board as a class have the students play one of the games below:  Build a Coaster: <http://kids.discovery.com/games/build-play/build-a-coaster>  Wholaler Coasters: <http://pbskids.org/fetch/games/coaster/>  Ultimate Rollercoasters: <http://www.ultimaterollercoaster.com/>  On one of the game point out where the greatest amount of potential and kinetic energy are. Discuss what happens when a larger force is applied to the coaster. Explain how the force affects the speed and motion of the coaster.  Introduce the challenge to the class and have the students complete the ask/engage part of their student journal.  **Challenge:**  Congratulations! You have been selected by Six Flags to design and build a thrilling new roller coaster with drops, loops, and hills. You will need to use your knowledge of force and motion to test a different size marbles to explain how force affects speed and motion. | | |
| 1. **Imagine/Brainstorm (day2)** | | |
| **Criteria:**  Your coaster must have:   * A name * One loop * One hill * Stand freely * Have a start and finish line labeled * Be able to explain how force affects speed and motion using different size marbles * Decrease your speed time from test 1 to test 2   **Constraints:**   * Use the materials provided * Complete the challenge within the time allotted   Have students individually think of a solution to the problem and draw and label their design. | | |
| 1. **Plan/Design (day 3)** | | |
| Each student will present their ideas to their team.  Teams will collaborate and decide on a final design plan.  Students draw and label their final design plan and make a list of needed supplies.  Build their design according to their plan. | | |
| 1. **Create / Test (day 3 continued- day 4)** | | |
| Student teams build their design according to their design plan.  Students will conduct test 1 and record their time. | | |
| 1. **Evaluate/Improve –** and repeat Steps 1-5 **(day 5)** | | |
| Students evaluate their design for success.  Did it meet the established criteria?  Did their final design match their planned design?  How would students improve their design?  Students will conduct test 2 to see if they decreased their time. | | |

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Roller Coaster Rally STEM Challenge

4th Grade



**Challenge**:

Congratulations! You have been selected by Six Flags to design and build a thrilling new roller coaster with drops, loops, and hills. You will need to use your knowledge of force and motion to test a different size marbles to explain how force affects speed and motion.

**Criteria:**

Your coaster must have:

• A name

• One loop

• One hill

• Stand freely

• Have a start and finish line labeled

• Be able to explain how force affects speed and motion using different size marbles

**Constraints:**

**•** Use the materials provided

• Complete the challenge within the time allotted

**Materials:** Various materials will be provided by your teacher.

1. **ASK / ENGAGE:** What is the problem you are being asked to solve?

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1. **IMAGINE/BRAINSTORM:** What are some possible solutions to the problem that you are trying to solve? After you brainstorm, draw and label your ideas below.

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| **Idea #1** | **Idea #2** |

1. **PLAN/DESIGN:** Share your ideas with your group and collaborate to decide on a final design plan. Draw your team’s design below and make a list of the materials that you will need to complete your design.

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| **Team Design Plan** | **Materials List** |

1. **CREATE/TEST**: Use your Final Design Plan to create and build your solution. Test your design. Did it work? Why or Why not?

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1. **EVAULATE/IMPROVE:**  How well did your design work? Did your solution solve the problem within the given constraints?

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How can you improve your design? How can you make it better? Draw and label your improved design below.

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| **Improved Design Plan** |