Name _____ Period ___ Date Started _____

STEM: Roller Coaster Challenge

Science Grade 8

Purpose: Use physics concepts such as motion, forces and energy to build the optimal roller coaster.

This project will be addressing all of the concepts of physics that we have covered during this school year so far. It will allow you to demonstrate your knowledge of motion, forces and energy.

You and your engineering team have been contracted to a task at the newest amusement park. You must design the optimal roller coaster ride. The owner of the park, Ms. Shin, will need you to create a model of a roller coaster. Your coaster must include at least one loop and no more than two loops. You have three and a half class periods to design the roller coaster.

You will need to be able to explain your roller coaster to the board of directors at Ride of Your Life Amusement Park. You will need to include in your explanation why you think your roller coaster is the best choice and should be built in the amusement park. Keep in mind that the board of directors is made up of a team of scientists. You will want to impress them with your knowledge of how forces, motion and energy help your roller coaster work, why it is safe to ride and why it is so much fun. Your model will be judged on the following:

- Safety
  - The marble must stay on the track at all times. Therefore, the roller coaster must bring your marble safely to a stop. The marble must be safely caught by the track at the end without getting stuck.
- Fun
  - Speed (velocity): Your team's ride will be timed with a stopwatch, the faster the time, the more the fun!
  - Number of Loops/drops: The more loops, the more fun! (must have one, no more than two). Include at least one drop.
- Always remember to test your design and record your data! Also remember that good engineers are great researchers, take good notes on your background research!

Engineer Team Name: _____

Engineer's Names: _____

_____

***Extra time will not be permitted. Deadlines are absolute. Absences will not result in extra class time. You may come in after school if you need more time.

Each team member must keep a materials list in their lab notebook. Each group member should copy down the cart below leaving additional space for the items your team chooses to use during the week.

Roller Coaster Physics Materials Sheet

Date	Item	Quantity

Step 1:

Title your lab notebook **"Step 1 – Individual Sketch"**. Come up with an individual design that you think will fulfill all of the necessary needs above. You want to sell your sketch to your group so make sure you can explain why you chose your parameters – explain them by labeling and taking notes under your sketch.

Step 2:
After your sketch is complete title your lab notebook "**Step 2 – Collaborating**". Listen to each group member's ideas and take notes in your notebook to look back to when deciding on a final design.

Step 3:
As a group decide on a design. Label your lab notebook **"Step 3 – Group Sketch"** Each person much sketch the design. When sketching use labels if needed. When EVERY person in the group is done with the sketch ask your teacher to come and approve the sketch with her initials on each picture.

Step 4:
Gather materials and start the design process with your team. Once your design is complete test it and label your group sketch with the following:

- Height and width of each loop
- Height of each drop (rise)
- Distance to each loop (run)
- Where Kinetic Energy is the highest
- Where Kinetic Energy is the lowest
- Where Potential Energy is the highest
- Where Potential Energy is the lowest
- Time of ride (seconds)
- Mass of the marble (kg)
- Length of the track (meters)
- Using the information above calculate the average speed. Show your work.

**IT IS EXTREMELY IMPORTANT TO MAKE SURE YOU ARE LABELING AND TAKING ACCURATE NOTES. YOU WILL HAVE TO DISASSEMBLE YOUR ROLLER COASTER EACH DAY, THEREFORE TO REASSEMBLE IT APPROPRIATELY YOU WILL NEED TO HAVE ACCURATE MEASUREMENTS.

Step 5:
As a group decide on any modifications that need to be made. You can only make one modification at a time and every time one is made you must make a written statement in your lab notebook regarding what the change was and why it was made. If you make modifications label your statements as "**Modification #1", "Modification #2"** and so on.

Your design process is complete when you believe you have the most fun (fastest) and safest (marble stays on track) roller coaster. At this time you must draw a final draft in your lab notebook titled "Final Draft" with all of the items labeled appropriately in your lab notebook.

Step 6:

Title this section of your lab notebook "**Presentation".** Prepare your explanation to the class. Remember you will need to include why you think your roller coaster is the best choice and should be built in the amusement park. Keeping in mind that the board of directors is made up of a team of scientists, you will want to impress them with your knowledge of how forces, motion and energy help your roller coaster work, why it is safe to ride and why it is so much fun.

Step 7:
This is where we test the class data. Each group must duplicate the charts below into their lab notebooks with the title "**Class Data**"

Group	Distance of total trip	Time of total trip	Velocity of total trip

Distance to first loop	Time to first loop	Velocity to first loop	Momentum to first loop

Conclusion Reflection: On the back of this page write a rough draft reflection of this STEM lab.

Include the information below:

- What was the purpose of completing this lab?
- What information did you use to plan your model? Use key terms from science class to explain.
- Did your model change during construction? If so, what did you change and why did you change it. If not, explain why no changes were needed.
- How can you relate this lab to each of Newton's Laws of Motion?
- How can you relate this lab to your basic understanding of energy? If you aren't sure do some research and/or use the article to aid in your response.
- Now that you have seen everyone's roller coaster what would you have done to make yours better? What advice would you give to an amusement park engineer?