Marble Roller Coaster

**Scenario:** You are president of an engineering firm that designs and builds roller coasters. Six Flags has just commissioned you and your team of highly trained and specialized engineers to design their new roller coaster. This is to be the premier roller coaster in the world. It is to be faster and more thrilling than any other coaster.

**Assignment:**

* You are to design (draw) and build a roller coaster.
* A marble must be able to travel through your roller coaster from start to finish.
* Your roller coaster must contain some type of loop.
* Labeling of the roller coaster using vocabulary words that will be listed farther into the instructions.
* You must find a way to stop the roller coaster.
* Answer the questions on the back of this paper with your group.

**Materials:**

* Cardboard tubes of various lengths
* Masking tape
* Scissors
* Large marble
* Paper and pencil
* 1 marble
* Any other materials that you wish to use must be approved before they are used in the construction of the roller coaster.

**Guidelines:**

1. Any type of roller coaster is acceptable, as long as it is functional and safely performs the assigned task within the design specifications.

* Maximum dimensions (LWH) 36X24X30

2. The marble must begin at the top of the coaster and end at the bottom, coming to a stop on its own.

* Your team is responsible for coming up with a way for the marble to come to a safe stop.

3. The coaster must successfully work at least three out of five times!

4. Magnets, electricity, springs, and other forms of energy may not be used- this is a “gravity ride” only.

5. No one is permitted to touch the coaster once the ride begins during testing, all supports must be in place ahead of time.

* Do not mess around with another group’s roller coaster.

6. Deadlines will be **absolute**. (Use your time appropriately, the due dates will not change!)

7. Your group is responsible for completely removing your roller coaster and cleaning the surrounding area after every class construction day. All classroom equipment or materials that you have must be returned from where they came from. Do not damage any classroom materials if you are unsure whether or not you can use something you must ask!

Awards will be given to the best of the roller coasters between my two classes.

* Best scenery- Lots of quality scenery covering the entire coaster and platform. Spending money on fancy scenery will not automatically make you a winner. Simple but clever or well done, thematic ideas that support the name work well.
* Best theme- What’s the name of your roller coaster? Does your scenery support this theme? Does the design support your theme? Is there a coolness or cleverness factor to your name?
* Most creative design element- Looking for something different. You may use items not made from paper for this.
* Most complex design- Wow. We’re looking at the loops, twists, dips, turns, etc.

**TASKS FOR EACH TEAM MEMBER**

**1 – TEAM COORDINATOR**: A leader will be selected by the team who will have the following responsibilities:

• The team coordinator will keep track of all team members to ensure the project is on schedule,

• Ensure that the design specifications developed by the team are followed.

• Collect the following: 1. All design drawings 2. All test data 3. Simulation results 4. Pictures of the completed project and members of the team 5. All physics calculations (there are at least a dozen)

**2 – DESIGN COORDINATOR**: This position will also be selected by the team and will have the following responsibilities:

• The design coordinator will keep track of all designs proposed and facilitate all discussions as to redesigns and or modifications.

• Oversee and obtain all materials needed for the project.

• Oversee all construction and ensure that it conforms to the design agreed upon.

**3 – TESTING COORDINATOR:** This selected position will be responsible for the following responsibilities:

• The Testing coordinator will oversee all tests and determine if modifications are required.

• Consult with the team if modifications are required.

• Collect all data from each test. Solicit help from team members to obtain data.

• Test over and over again until data variations are within acceptable error.

**4 – PRESENTATION COORDINATOR:** This selected position will be responsible for the following responsibilities:

• Take all pictures (or drawings) to make a record of the project.

• Prepare data for proper presentation.

• Oversee the write-up of this project to include: 1. Cover page with creative design, title, and names of participants, period & date. 2. Table of contents with page numbers. 3. Brief history of roller coasters (in your own words, **not** cut and paste from the Internet). 4. Discuss the motion a coaster experiences as it travels. This information is also available from the Internet. Include diagrams to explain what a passenger on a coaster would experience. Again, this must be in your own words not copied from the Internet. 5. Purpose of this project: include all direct and indirect variables. 6. Complete equipment list. 7. Procedure of how the coaster was built including all redesigns. Be sure to include a three dimensional drawing of your model including all measurements. 8. Computer simulation results in table form. 9. Data collected include all trails, not just your best results. 10. Data analyses include all calculations and formulas used. 11. Develop any graphs that are appropriate to the data collected. 12. Describe all physics concepts that are integral to this project. 13. Task outline with names and positions of all coordinators.

**Marble Roller Coaster Group Scoring Rubric**

\_\_\_\_\_ 25 pts. Coaster contains *at least* one loop, one spiral, two camel backs, and an inversion

\_\_\_\_\_ 10 pts. The roller coaster has a theme.

\_\_\_\_\_ 10 pts. Made from scratch, open-topped, sturdy

\_\_\_\_\_ 10 pts. Marble stays on track the whole time and completes the coaster

A detailed **narrative** (written or typed) including each of the following components:

\_\_\_\_\_ 5 pts. an explanation of the motion of the marble through the coaster

\_\_\_\_\_ 10 pts. an explanation of how the marble’s motion would be different if the top height of the coaster was higher and the mass of the marble is greater

\_\_\_\_\_ 10 pts. a description of the changes in the marble’s speed, velocity and acceleration throughout the coaster

\_\_\_\_\_ 10 pts. kinetic and potential energy changes throughout the coaster

\_\_\_\_\_ 5 pts. Where is the kinetic energy the highest?

\_\_\_\_\_ 5 pts. Where the kinetic energy is the lowest?

\_\_\_\_\_ 5 pts. Where is the potential energy the highest?

\_\_\_\_\_ 5 pts. Where is the potential energy the lowest?

\_\_\_\_\_ 5pts. a description of how gravity impacts the motion of the marble through the coaster

*\_\_\_\_\_* 5 pts. The names of your group members are on the project

**Criteria for presentation**

\_\_\_\_\_ 10 pts. Presentation of roller coaster (2-3 minutes)

\_\_\_\_\_ 5 pts. Information was organized

\_\_\_\_\_ 5 pts. Appearance: Does the roller coaster look good? Is it neat? Does it have a name?

\_\_\_\_\_ 5 pts. Safety: Does the marble stay on the track? Does the marble complete the entire track without getting stuck or stopping? Does it come to a safe stop at the end of the ride?

\_\_\_\_\_ 5 pts. Thrill: Is the track open for all/ parts of the ride? Can the passengers “see” out? How abrupt are any changes in motion? Are there any jumps?

\_\_\_\_\_\_\_\_\_ / 150 pts

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| *Marble Roller Coaster 21st Century Skills Individual Rubric* |
| |  |  | | --- | --- | | Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Teacher: Mrs. Tosh | |
| |  |  | | --- | --- | | Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Title of Work: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |
| |  |  |  |  | | --- | --- | --- | --- | | |  |  |  | | --- | --- | --- | | **Skills** | **Criteria** | **Points** | | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | 1 | 2 | 3 | 4 |  | | **Helping**  The teacher observed the student offering assistance to other students. | *None* of the Time | *Some* of the Time | *Most* of the Time | *All* of the Time | \_\_\_\_ | | **Listening**  The teacher observed the student working from the ideas of others. | *None* of the Time | *Some* of the Time | *Most* of the Time | *All* of the Time | \_\_\_\_ | | **Participating:**  The teacher observed the student contributing to the project. | *None* of the Time | *Some* of the Time | *Most* of the Time | *All* of the Time | \_\_\_\_ | | **Persuading:**  The teacher observed the student exchanging, defending, and rethinking ideas. | *None* of the Time | *Some* of the Time | *Most* of the Time | *All* of the Time | \_\_\_\_ | | **Questioning:**  The teacher observed the student interacting, discussing, and posing questions to all members of the team. | *None* of the Time | *Some* of the Time | *Most* of the Time | *All* of the Time | \_\_\_\_ | | **Respecting:**  The teacher observed the student encouraging and supporting the ideas and efforts of others. | *None* of the Time | *Some* of the Time | *Most* of the Time | *All* of the Time | \_\_\_\_ | | **Sharing:**  The teacher observed the student offering ideas and sharing well with others in a calm and respectful manner. | *None* of the Time | *Some* of the Time | *Most* of the Time | *All* of the Time | \_\_\_\_ | | | |  |  | | --- | --- | | **Total Points** | \_\_\_\_ | | |