Roller Coasters - Quarter 3 Project

Purpose: To design a roller coaster that provides thrills (g-forces & vertical loops), no spills (marble makes it the whole length of the coaster without falling out), and a maximum ride time.

Targets:

B2. Skills and Traits of Technological Design

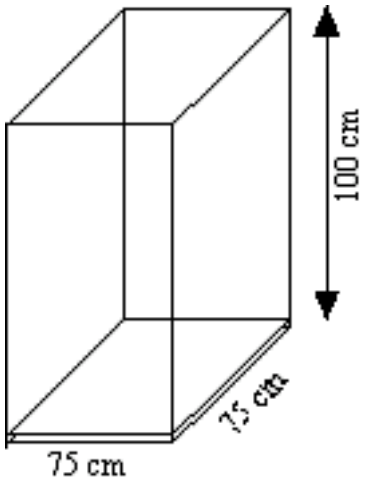
Students use a systematic process, tools and techniques, and a variety of materials to design and produce a solution or product that meets new needs or improves existing designs.

D3. Matter and Energy

i. Explain the relationship between kinetic and potential energy and apply the knowledge to solve problems.

Specifications:

- You may work with a partner.
- A glass marble or steel ball will "ride" your roller coaster. You must provide this object for testing day. Bring extras in case you lose one.
- The marble/ball will be released from rest at the top of the first hill.
- The base of the coaster may not exceed 75 cm X 75 cm.
- The height of the coaster may not exceed 100 cm.
- All parts of the coaster (including decorations) must fit within a 75 cm X 75 cm X 100 cm box as shown below.



- The starting position at the top of the first hill should be clearly marked. The steel ball or glass marble must end in a designated area or container.
- No motors or propulsion systems other than gravity!

Before Testing Day:

- Before building your coaster, use the metal track with a loop in your classroom to determine how the height of the hill relates to the diameter of the loop for a ball to make it around the loop without falling out.
- Take photos of your coaster from several perspectives and bring them the day of the competition. If digital, also email them to pperry@lewistonpublicschools.org for inclusion on the class website.

Testing procedure/Calculations

- Marble/ball will be released at the beginning of the coaster and timed (with either photogates or a stopwatch) until it reaches the end.
- Final time will be the longest of three trials. If the marble falls off the coaster during a trial, you lose that trial.
- Calculate what the potential and kinetic energy of the marble would be if no energy were dissipated due to friction for 5 spots of differing heights on your track. Label these spots with the letters A-E on your coaster. Spot "A" should be the top of the first hill.

Prelab Data: (using metal loop-de-loop track in class)

diameter of metal loop = _____ cm
height of drop to make it around loop = _____ cm
ratio of drop height to loop diameter = _____

Data from testing day:

mass of marble = _____ g = _____ kg

Time to complete rollercoaster

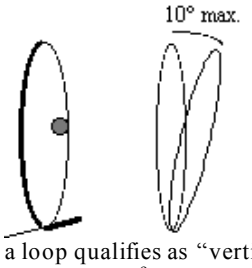
Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	longest time (s)

Spot on track	Height above lowest point on coaster (cm)	Height above lowest point on coaster (m)
A		
B		
C		
D		
E		

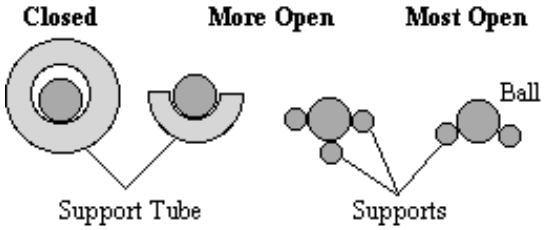
Calculations: (show work on the back)

Spot on track	Potential energy (j)	Kinetic energy (j)
A		
B		
C		
D		
E		

Lab Rubric



a loop qualifies as "vertical" if within 10^{o} of vertical



	0 points	5 points	10 points	15 points	20 points
performance rank among all students for most amount of time	marble doesn't make it to the end of track	1-25%	26-50%	51-75%	76-100%
engineering & creativity	project does not meet specs	some specs not met and/or rickety	some novel parts, meets all specs	several novel parts, meets all specs, evident theme, good construction	novel design, meets all specs, theme throughout, quality construction
degree of openness (see picture above rubric)	100 % closed	~20% open	~40% open	~60% open	>80% open
thrills & vertical loops	humdrum ride	no vertical loop, but at least one area of high g-force	one vertical loop but multiple straight stretches over 30 cm	one vertical loop, and other areas of high g-force	two or more vertical loops, and other areas of high g-force
calculations/data	missing		somewhat accurate and complete	accurate and complete, work is shown	accurate and complete, work is shown , all numbers include units & have correct sig. figs

Your rank for time: _____ Final Grade : _____

Picture provided? yes/no (5 points off final grade if no pic)