Roller Coasters!!

Introduction:

We have been studying concepts such as Work, Power and Energy. We have learned about two types of energy, kinetic energy (energy of motion) and gravitational potential energy (energy due to position relative to the center of the earth. We have also learned that the total amount of energy in a system is conserved (stays the same) in the absence of friction (or *dissipative forces*). Definitely one of the most fun examples of the interplay between Gravitational Potential Energy and Kinetic Energy is the **Roller Coaster**!

We are going to build roller coasters! Roller Coasters are an excellent example of energy conservation at work (and play). Each group will build a roller coaster (using a marble or steel ball as the rider) out of materials of their choice (discussed below).

Coaster Model Rules

(a) Size restrictions – Coaster must be confined to the area above and vertically to the width of your table.

(b) The model should be designed for a steel ball or glass marble. This means that the steel ball or glass marble when released from the top of the first hill by the judge will travel through the entire ride, and arrive at the bottom loading platform. (Note: for this contest, you will raise the steel ball or glass marble by hand from the loading platform to the top of the first hill to start the "ride".)

(c) A ball must be provided by the team so that it can be tested on judging day. The ball must be either a glass marble of regular size or greater, or a steel ball that is 1 cm (1/2") in diameter or greater.

(d) Magnets, electricity, springs and other forms of energy may not be used - this is a "gravity ride" only. These other sources of energy can be used for esthetics (ie, background lighting).

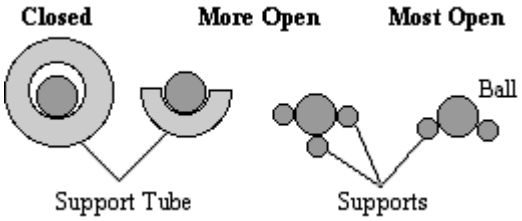
(e) The starting position at the top of the first hill should be clearly marked. The steel ball or glass marble must end in a designated area or container.

The scoring for our version will be weighted as follows: Technical Score = 50%, Creativity Score = 50%

Technical Score = 80 X (Openness Factor) X (Loop Factor) X (Time Factor)

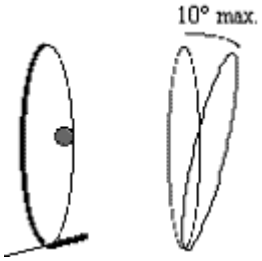
Openness Factor

% open	factor
< 50%	0.7
50% - 80%	0.9
> 80%	1.0



Loop Factor

# of vertical loops	factor
0	0.6
1	0.8
2	1.0
3	1.2
4	1.5



Vertical loop is defined as any time the "rider" is upside down on a loop of track that is within 10° of vertical (see illustration). If the vertical loop is a portion of a corkscrew (helix), it counts as a vertical loop. Horizontal loops do not add bonus points.

Time factor

The points awarded for time will be based on the maximum time taken within the class. Assume the maximum time was 15 seconds and your coaster took 9 seconds:

Points = 1.0 point x (your time / maximum time) **For example**: Points = 1.0 point x (9 sec / 15 sec) = **0.6**

Creativity Score is the total of points received from the following table. These scores will be determined by judges (other students) who will give each roller coaster a score in each of the four categories below.

# of points	1	3	5
Engineering	Nothing Unusual	Some Novel Materials or Design	Alot of Unique Design
Theme	No Theme	Some Theme But Not Much	Theme Done Well Throughout
Realism	Unrealistic	Harsh	Safe
Fun	Boring	Not Bad	Exciting

The technical score is added to the creativity score to give the final or total score for the roller coaster.

Groups will have a designated amount of time to work on roller coasters in class. Judging will be conducted by myself and the chemistry lab groups. It is estimated that 3-4 hours of out-of-class time will be required prior to the in-class work week to complete the project in a comfortable amount of time.