



The WonderCoaster Contest – 2013

PLEASE NOTE THAT THESE RULES ARE SLIGHTLY DIFFERENT FROM THE ONES USED IN 2012.

IF YOU HAVE ANY QUESTIONS PLEASE SEND E-MAIL TO:

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Canada's Wonderland is proud to present The WonderCoaster Contest, in conjunction with the Physics, Science & Math Program, on Friday, XXXXX, 2013. To find out how you and your school can enter this exciting contest, read the rules and suggestions that follow.

Roller coasters are called "gravity rides" for a good reason: once the coaster has been dragged to the top of the first hill and released, it is the force of gravity that keeps the coaster going all the way back to the station platform at the end of the ride. As the coaster goes through its twists, turns, rolls, and loops, it gains and loses speed and its initial potential energy (supplied by dragging it up the first hill) changes from potential into kinetic energy and back into potential energy. Since some of this initial energy is lost due to friction, the roller coaster can never rise as high as the first hill. The roller coaster you will design is also a "gravity ride".

There are two divisions (a) Elementary Schools and (b) Secondary Schools. In each division prizes will be awarded in the following three categories:

- (a) **Technical Merit** - the roller coaster that is determined by the judges to record the highest score according to the technical merit calculation shown on page 2 and 3 will be declared the **Best Roller Coaster for 2013**. First and Second prizes will be awarded in this category.
- (b) **Creativity and Artistic Value** - the roller coaster that is, in the opinion of the judges, the most creative and makes the best use of available materials. First and Second prizes will be awarded in this category.
- (c) **Most Exciting to Ride** - the roller coaster that is the one that would be the most exciting to ride if it was constructed for humans at **Canada's Wonderland**. Judging this category will be Alex Ilic, Ride Engineer from Canada's Wonderland

Note: A team can only win a prize in one category

Check out this web page for some pictures from previous years;

<http://ntci.on.ca/departments/physics/wondercoaster/2012/>

(Thanks to Mark Kinoshita from North Toronto Collegiate and Sai Chung from A.Y. Jackson SS)

Coaster Model Rules - All Categories

- (a) Size restrictions - base support must not be more than 25 cm x 75 cm and the height of the model above the base must not be more than 80 cm. The complete coaster must be able to fit into a box that has dimensions of 25 cm x 75 cm x 80 cm. **Please be aware of the size restrictions that might also be imposed by the method of transportation (school bus) you will be using to get to Wonderland.**
- (b) Magnets, electricity and other forms of energy may **NOT** be used - this is a "gravity ride" that utilizes **ONLY** the initial gravitational energy possessed by the steel ball or marble when lifted to the top of the ride. Other sources of energy can be used for aesthetics (i.e. background lighting). The maximum allowable voltage is 9 V DC battery.
- (c) The model should be a working model 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, the steel ball or glass marble is manually lifted from the loading platform to the top of the first hill to start the "ride".)
- (d) The minimum size of the steel ball or glass marble is 1.3 cm. The maximum size of steel ball or marble is 2.5 cm.
- (e) A steel ball (or glass marble) must be provided by the team so that it can be tested on judging day. Make sure you have extras in case one gets lost.
- (f) Material such as the following can be used: wood, plastic, metal or plastic tubing, wire, string, twine, doweling, toothpicks, cardboard, construction paper and glue or virtually any other material. The total cost of the model should be kept to a minimum.
- (g) The starting position at the top of the first hill should be clearly marked.
- (h) Live animals and fish can not be used in the display.
- (i) Each competing team can have a maximum of 4 students and a minimum of 2 students.
- (j) The maximum number of teams entered per school is 4.
- (k) **Teams will only be allowed 15 minutes to set up and adjust their roller coaster in the judging area** (as you arrive the time will be noted and you must leave the stage within 15 minutes). **Judging will begin at 10:30 am sharp** and all teams must leave the judging area. Bring a level to ensure the coaster is level before judging commences. Late entries will be allowed but they will have limited time in the judging area. **The coasters are judged in an outdoor environment and wind and cold weather conditions sometimes exist. This is a difficult factor for you to consider when building your coaster but you should be aware of it.**
- (l) Additional rules related to the TECHNICAL MERIT score assigned to the model are shown on the next page.
- (m) **The decision of the judges is final. Any coaster that violates the spirit of the competition and the rules will be disqualified.**
- (n) **The awards ceremony will begin at 2 pm sharp in the judging area.**

*******The Roller Coaster Information Sheet (page 4) *MUST* accompany the coaster or it will not be judged. This must be signed by your teacher*******

Judging Criteria - Technical Merit Category

The **Technical Merit** of your coaster will be determined according to the following equation.

(vertical drop in cm) x (vertical diameter factor in cm) x # vertical loops) x (time of travel in seconds)

ADDITIONAL RULES RELATED TO THE TECHNICAL MERIT SCORE

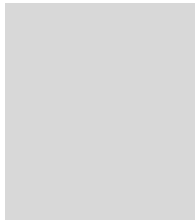
- (a) In order to receive a technical merit mark the steel ball or marble must complete the entire "ride" 1 out of 3 trials when tested by the judging team. Teams should have their coaster 'tested' by a judge before leaving the competition area in the morning.
- (b) There must be a **continuous fixed track** that the steel ball or marble follows.
- (c) **Time Score Calculation:** The maximum time score allowed is 40 seconds - if the time is less than 40 seconds then the time factor is the recorded time; if the time is between 40 and 55 seconds then the time factor will be 40 (no penalty); if the time is more than 55 seconds then the time factor will be 40 MINUS the amount of time greater than 55 seconds (for example if your time is 61 seconds then your time factor will be $40 - (61 - 55) = 34$).
- (d) **Vertical Loop Diameter score calculation:**
Determine the total diameter score of each of the vertical loops. For loops that are not circular, record the diameter at the LARGEST spot. The coaster ride must have at least one vertical loop. **To be considered a vertical loop the angle of the loop with respect to the vertical must be less than 20°** (otherwise it is considered a horizontal turn).
A vertical corkscrew (like the final two loops on Dragon Fire at Wonderland) is a special case type of a vertical loop. Each complete revolution of 360° will count as one complete vertical loop. These will be recorded to the nearest 1/4 of a loop. Horizontal corkscrews are not included in the score.
- (e) **ONLY TWO VERTICAL LOOPS CAN BE LOCATED ADJACENT TO EACH OTHER. YOU ARE ALLOWED TO HAVE AS MANY OF THESE DOUBLE VERTICAL LOOPS AS POSSIBLE BUT THERE MUST BE AT LEAST 10 CM** (measured from the bottom of the end of the last loop of one double loop to the start of the bottom of the first loop of the second double set) **OF TRACK SEPARATING EACH DOUBLE VERTICAL LOOP.** Photos of the winning coasters in 2012 are shown on the web page noted above. Many of these coasters had multiple double loops but please be aware that the minimum distance between the double loops this year is 10 cm whereas it was 15 cm in 2012.
- (f) The velocity of the ball must be changing (in either magnitude &/or direction) for the entire trip. Coasters will be eliminated if the velocity remains constant for more that two seconds (this means the track should not be straight and level for more that 2 seconds of travel).
- (g) The maximum length of any straight section of track is 25 cm.

Example: A model with the following characteristics would receive the technical merit score calculated below:

- (i) vertical drop of 80 cm
- (ii) 8 individual vertical loops that with a diameter of 5 cm (score as 8 loops x 5 cm)
- (iii) 3 double vertical loops each with a diameter of 7 cm (scores as 3 x 2 loops x 7 cm)
- (iv) one open corkscrew (see the definition of a corkscrew on the next page) of 360° with an average diameter of 6 cm (score as 1.0 loops x 6 cm)
- (v) that takes a total of 61 s from start to finish (score as $40 - (61-55) = 34$ as per rule (c) above)

(vertical drop in cm) x (vertical diameter score in cm) x (# vertical loops) x (time factor in seconds)

$$80 \times [(8 \times 5) + (3 \times 2 \times 7) + (1 \times 6)] \times 15 \times 34 = 3\,590\,400 \text{ pts}$$



Roller Coasters will NOT be allowed on the stage for judging unless they are accompanied by this sheet

Roller Coaster Information Sheet - 2013

PLEASE PRINT

School Name: _____

Coaster Name: _____

Is this a secondary or elementary school? _____

Members of the group: _____
(and grades) _____

PLEASE PRINT

Complete the following chart if you want to be judged in the Technical Merit Category:

Criteria:	score
Vertical Drop Score in cm (MAXIMUM 80 cm) (top to bottom straight down)	
Time Score - Total time of travel (use rule (c) on page 3 to calculate this score)	
Vertical loop diameter score (cm) (use the information on page 3 rule (d) and (e) on how to calculate this number)	
# of Vertical Loops (just the total # of vertical loops including corkscrews)	
Technical Merit Score (use the equation shown on page 3 to calculate your technical merit score)	
Teacher's signature:	

Use the equation shown on page 3 to calculate the Technical Merit score for your coaster and enter it on the chart shown above. This will be verified by the judging team.

If you are in doubt about any measurement, just place a question mark in the appropriate box and the judges will make the measurement.

Before you leave the Judging area ask one of the judges to verify that your coaster WORKS

Working - YES / NO Judges Signature: _____