

# The WonderCoaster Contest

PLEASE NOTE THAT THESE RULES ARE SLIGHTLY DIFFERENT FROM THE ONES USED IN 2008.

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, May 8, 2009. 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".

## Prizes will be awarded in the following 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 2009**.
- (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.
- (c) **Best Elementary School Roller Coaster** - the roller coaster that is the best one constructed by students enrolled in an elementary school (grade 8 or less).
- (d) **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**. The Ride Engineer from **Canada's Wonderland** will judge this category.

**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/2008/>

(Thanks to Mark Kinoshita from North Toronto Collegiate)

## **Coaster Model Rules - All Categories**

- (a) Size restrictions - base support must not be more than 30 cm x 80 cm and the height of the model above the base must not be more than 85 cm. The complete coaster must be able to fit into a box that has dimensions of 30 cm x 80 cm x 85 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.
- (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) The primary construction material may be wood. Other suggested materials include wire, string, twine, doweling, toothpicks, cardboard, construction paper and glue. 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 International Showplace (venue subject to change).**

**The Roller Coaster Information Sheet (page 4) and calculation of the vertical diameter score *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 (time of travel in seconds) x (vertical diameter factor in cm) x (# vertical loops)**

(The method to calculate the vertical diameter factor score is shown on the next page)

### 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.
- (b) There must be a **continuous fixed track** that the steel ball or marble follows.
- (c) The maximum time score allowed is 30 seconds - if the time is less than 30 seconds then the time score is the recorded time; if the time is between 30 and 45 seconds then the time score will be 30 (no penalty); if the time is more than 45 seconds then the time score will be 30 MINUS the amount of time greater than 45 seconds (for example if your time is 50 seconds then your time score will be  $30 - (50 - 45) = 25$ ).
- (d) The overall technical merit score will be reduced by 25% if the track is not open for at least 25% of its total length.
- (e) **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. If the vertical loop is open at the top of the loop (so that the steel ball or marble would fall out if it was moving too slowly) on the inner side then the diameter that is counted should be multiplied by 1.5. **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 corkscrew** 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.
- (f) **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 7 CM OF TRACK SEPARATING EACH DOUBLE VERTICAL LOOP. \*\*\*THIS IS A NEW RULE FOR 2009 \*\*\***
- (g) 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).
- (h) The maximum length of any straight section of track is 30 cm.

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

- (i) vertical drop of 85 cm
- (ii) 8 individual vertical loops that are open at the inside on the top with a diameter of 5 cm (score as  $8 \text{ loops} \times 5 \text{ cm} \times 1.5$  (open at the top))
- (iii) 3 double vertical loops each with a diameter of 7 cm and open at the top (scores as  $3 \times 2 \text{ loops} \times 7 \text{ cm} \times 1.5$  (open at the top))
- (iv) 1 vertical loop that is closed at the top with a diameter of 8 cm. (score as  $1.0 \times 8 \text{ cm}$ )
- (v) one open corkscrew (see the definition of a corkscrew on the next page) of 360° with an average diameter of 6 cm (score as  $1.0 \text{ loops} \times 6 \text{ cm} \times 1.5$  (open loops at the top))
- (vi) that takes a total of 66 s from start to finish (score as  $30 - (66-45) = 9$  as per rule (c) above)

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

$$85 \times 9 \times [(8 \times 5 \times 1.5) + ((3 \times 2 \times 7 \times 1.5) + (1 \times 8) + (1 \times 6 \times 1.5))] \times 15 = 1\,713\,600 \text{ pts}$$

# Roller Coaster Information Sheet - 2009

This **MUST** accompany all roller coasters competing in the technical merit category

**PLEASE PRINT**

School Name: \_\_\_\_\_

Coaster Name: \_\_\_\_\_

Is this a secondary or elementary school? \_\_\_\_\_

Members of the group: \_\_\_\_\_  
 (and grades) \_\_\_\_\_

**PLEASE PRINT**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

<b>Criteria:</b>	<b>score</b>
<b>Vertical Drop Score</b> in cm (MAXIMUM 85 cm) (top to bottom straight down)	
<b>Time Score</b> - Total time of travel (top to bottom) in seconds - see rule (d) on page 3	
<b>Vertical loop diameter score</b> (cm) see the information on page 3 rule (e) and (f) on how to calculate this number	
<b># of Vertical Loops</b> (just the total # of vertical loops including corkscrews)	
<b>Technical Merit Score</b> (use the equation shown on page 3 to calculate your technical merit score)	
<b>Teacher's signature:</b>	

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: \_\_\_\_\_