**WEST VANCOUVER DISTRICT PHYSICS OLYMPICS**

**Wednesday, February 18th 5:00 – 8:00 pm @ Rockridge**

**Welcome** to the second annual West Vancouver District Physics Olympics. This competition is for grade 11 and 12 Physics Students at Rockridge, West Van Secondary and Sentinel.

General Rules:

Each team may consist of up to 5 students. Each team will participate in two events. Each team must come up with a team name. Each event will run approximately one hour with dinner (provided) in between the events.

Interpretation of Rules:

Normal physics interpretations will be applied to all the terminology used in defining the challenges. Those solutions which, in the opinion of the judges, do not comply with the spirit of the event and intent of the rules will be disqualified from the event. The ruling of the event judges is final.

Pre-Build Events:

Both events are “pre-builds”. This means you design and build the device before the event. Pre-built devices will be checked-in prior to the competition. You will not be allowed to work on your device while others are testing. This includes BOTH devices for each of the two pre-build events.

Agenda: LOCATION: Rockridge SECONDARY SCHOOL

5:00 pm Check in devices

5:30 – 6:30 Testing for Descrambler

6:30 – 7:00 Dinner (Subway provided)

7:00 – 8:00 Testing for Looney Car

8:00 Results

**The Descrambler**

This is a prebuilt event in which participants must design and build a structure to protect an egg from breaking when a mass is repeatedly dropped on it from a height of one meter.

Teams will bring an apparatus consisting of three parts: **a base, a scrambler and an egg protecting structure.**

**Base**

1. The base must consist of a single rigid piece of hardwood (examples: oak, walnut, maple, poplar, birch, ash) no bigger than 30 cm by 30 cm by 3 cm (tall) and no smaller than 15 cm by 15 cm by 1.5 cm (tall).
2. The Egg Protecting Structure will be placed on the base.

**Scrambler**:

1. The scrambler must consist of a single rigid object composed of solid, completely rigid materials such as iron, lead, other metals, brick or hardened concrete.
2. The scrambler must be designed to fall freely with an acceleration of approximately **equal to g** when dropped. It must have a flat bottom surface that must be downward during at all times when dropped. ***The maximum diameter of this bottom surface must be no more than 20 cm***.
3. The scrambler must be designed to first impact the egg protecting structure without ever touching the ground or surroundings.

**Egg Protecting Structure:**

1. The egg protecting structure must be pre-made and free-standing.
2. The only materials that may be used in construction of the egg protecting structure are:

• Paper

• Flat wooden toothpicks

• ***Natural fiber string*** of less than 1 mm diameter. The string ***must not*** have any metal component in it, and must be non-mono-filament i.e. no fishing line or mono-filament dental floss. Please bring a sample of the string used.

• ***Small quantities*** of white glue to secure components together (teams that use super glue or a glue gun will be disqualified)

1. The egg protecting structure must be designed so that it does not fully encase or otherwise attach to the egg. Specifically it sits freely over the egg and can be freely lifted up both before and after a trial for examination of the egg.
2. The egg protecting structure must fit in a 20 cm by 20 cm by 20 cm box.
3. The height of your Egg Protecting structure (H) will be measured from the top of the base to the top of the Egg Protecting structure.

**Rules**:

1. Each team will be allowed up to 5 trials. ***Teams will be given a total time of 10 minutes to set up and run the trials.***
2. Teams will be given a single, extra-large, grade A egg. The egg is to be placed directly on the base. The egg protecting structure is then placed over the egg.
3. The base will be placed on a piece of flat cardboard on top of the floor to protect the flooring.
4. Each trial begins when the judges indicate that they are ready. A team member will then drop the scrambler from a **minimum height of 1.0 meter above the wood base** onto the egg protecting structure. This team member will be required to do so from a sitting or kneeling position on a table positioned~~.~~
5. The scrambler must freely fall with the flat bottom surface downward, approximately parallel to the wood base. The scrambler must hit the egg protecting structure first before touching anything. The scrambler’s center of mass must approximately hit the center of the egg protecting structure.
6. After the scrambler has come to rest, a team member will remove it and another team member will lift the egg protecting structure and show the judge the condition of the egg. The judge will evaluate the condition of the egg and place it in one of two categories - intact or broken.
7. The trial will be successful if the egg is intact and the fall of the scrambler satisfied rule 15 during the trial.
8. After each trial has ended, the team can choose to run another trial and if it does so, must quickly prepare for the subsequent trial by replacing the egg protecting structure over the same egg.
9. Remember teams will ONLY be given 10 minutes to complete all trials.
10. **The score will be given by the following formula**:



where:

* *i* is the number of **successful trials**
* *Mscrambler* is the mass of the scrambler **in grams**
* *Mstructure* is the mass of the egg protecting structure **in grams**
* *H* is the maximum height of the egg protecting structure **in centimeters**

All as measured upon check-in to the event. The largest score wins. Ties will be broken by the mass of the egg protecting structure with the least massive structure winning.

**The Looney Car (BC’s Best Driver)**

This is a pre-built event which involves the design of a car that utilizes the energy stored in three rubber bands to cover a 5.0 m course as quickly as possible while completing a legal right turn and then parking.

**Apparatus:**

1. The total energy for moving the car can only come from the elastic potential energy stored in at most, three size #32 rubber bands 3” x 1/8” (76 mm x 3.2 mm x 1.1mm). **The event organizers will supply the three rubber bands.** *They can be utilized in any way* and do not have to remain in original condition. They do not need to be returned to event organizers.
2. **The car must be constructed by the contestants themselves and may not consist mainly or exclusively of any sort of pre-purchased model kit or device**. The car's mass must be less than or equal to 2.0 kg and its length in any direction must be no more than 0.50 m at all times.

**The Event**

The car will move on an "L" shaped track marked on a linoleum floor. This track will be 5.0 meters long as measured along the inner edge of the L, and the bend in the L will be at 3.0 meters. The track will have three marked lanes, each 30 cm wide.

Behind the starting line there will be an area of about 1 meter in length for set-up of the car.

Immediately beyond the finish line there will be a parking area consisting of three stalls, each 30 cm wide and 50 cm long.

A successful car will start from rest at the starting line, travel down the track, turn 90 degrees, and stop in the parking area.

**Rules:** The rules for the event are as follows:

1. To begin a run, the car must be placed at the starting line with no part extending beyond this line. When the event organizers indicate to do so, a team member releases the car. No external intervention is allowed after the release of the car.
2. The car must remain in contact with the ground at all times. All parts of the car must remain on the track at all times. All parts of the car must cross the finish line and subsequently park in the parking area. In particular, note that no material or substance can be left behind the car at any point during the run.



1. The timer will start when the front of the car crosses the starting line and will stop when the front of the car crosses the finish line. If the car does not cross the finish line in 30 seconds, the run will be declared over (See rule 4). The car must then park (come to a complete stop in a parking stall) within an additional 15 seconds. A team member may stop a car that completely overshoots the parking stalls.
2. The score for a trial run is given by the formula:

Where:

* *T* is the time taken for your car to traverse the track from the starting line to the finish line measured in seconds
* *L* is the lane number of the lane farthest from the inner edge of the track that your car either partially or fully entered during the run
* *D* is the distance from the front most point of your car to the front of the parking stall in centimeters. A car that partially crosses the finish line is penalized by this scoring formula; ***as long as the car stops the clock, this formula will be used to calculate the score***.
* ***The winning car will be the car with the lowest score.***
1. If the car does not cross the finish line in 30 seconds, a time T = 10 + 150/x (x is the distance in meters traveled by the car) and a D of 100 will be used in calculating the score. The distance x will be the shortest distance from the front edge of the flag to the starting line. The score calculated in this manner will be higher than that of any finishing car; that is, all cars that cross the finish line will place above a car that does not.
2. Teams will be allowed two trials. A total time of 6 minutes is allowed for the setup and running of the two trials. The best score attained in the two trials will be used as the team score. In the event of a tie, the second score will be used to resolve the tie.

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**Data Sheet**

Team Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ School: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Number of Participants: \_\_\_\_\_\_\_

**The Descrambler**

Egg Protecting Structure fits inside a 20 by 20 by 20 cm box **yes/no**

Mass of Scrambler (g): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Height of Egg Protecting Structure (cm): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mass of Egg Protecting Structure (g): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Number of Successful Trials: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Looney Cars**

Car is less than 2.0 kg’s **yes/no**

Car’s length in any direction is less than 0.50 m at all times **yes/no**

**Trial 1:**

Lane (1, 2 or 3): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Time to transverse the track (s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Distance from front of the car to front of the parking stall (g): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

*If car does not cross the finish line in 30 seconds…*

Distance traveled by the car (m) \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Trial 2:**

Lane (1, 2 or 3): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Time to transverse the track (s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Distance from front of the car to front of the parking stall (g): \_\_\_\_\_\_\_\_\_\_\_\_\_\_

*If car does not cross the finish line in 30 seconds…*

Distance traveled by the car (m) \_\_\_\_\_\_\_\_\_\_\_\_\_\_