YSU Physics Olympics

Official Rules
Event Descriptions

March 21, 2009
Beeghly Center, YSU Campus

The Events:

EVENT #1 -- EGG DROP

OBJECT: To construct a container of original design, with minimum mass, so that it will protect a raw egg (medium size) from breaking or cracking when dropped from a fixed height of approximately 12 meters.

RULES:
1. Each team will be permitted one entry; a team can have up to two (2) members.
2. Each egg drop container must be constructed from ditto paper. Each team will be provided with 10 sheets of 8-1/2" x 11" ditto paper and 1 meter of transparent tape.
3. The use of construction aids such as scissors, model eggs, rulers and/or other construction devices is permitted but must be provided by the contestants.
4. The container can be of any design, but must fit through normal door openings.
5. Each team will be given 20 minutes to construct the container after which the container will be weighed by one of the judges.
6. Raw eggs (medium size) will be provided to the contestants at the time of the competition but not until the device has been constructed and submitted to the judges for weighing.
7. The container with the egg inside, will be dropped by one of the judges from a height of approximately 12 m.
8. The egg must survive intact (not cracked).

COMPETITION:
1. The contestant(s) must build the device at the contest site and within the allotted time period (20 minutes). No egg will be made available during construction.
2. The container (minus egg) will be given to the judge for weighing, identification, and for any needed launching instructions.
3. Each team will directly load its container with the raw egg supplied by the judges. One of the judges will observe the process of loading. Contestants must be able to secure the egg in the container within one minute.

SCORING:
1. The container with the minimum mass, and which survives the fall without breaking or cracking the egg, is declared the winner.
2. Second through fifteenth place winners will be determined in a similar manner.

EVENT #2 -- FERMI QUESTION

TEAM: Each team will consist of up to three (3) members.

QUIZ:
1. The quiz will consist of 12 "Fermi Questions."
2. A "Fermi Question" is a question in Physics which seeks a fast, rough estimate of a quantity which is either difficult or impossible to measure directly.

> *Examples: How many drops of water are there in Lake Erie?*

How many BB's will fill up a basketball?
How many blades of grass are there on a football field?

COMPETITION:
1. Each team will be given 20 minutes to answer as many questions as possible.
2. Each team is to work together and is to submit one answer sheet.
3. Scratch paper and pencils will be provided and will be collected at the end of the quiz.
4. Calculators will be allowed, but must be provided by the contestants.

SCORING:
1. An answer will be scored according to its power of ten.
2. Three (3) points will be given for all answers whose power of ten agrees with the power of ten of the official answer.
3. Two (2) points will be given for all answers whose power of ten differs by + 1 of the power of ten of the official answer.
4. One (1) point will be given for all answers whose power of ten differs by + 2 of the power of ten of the official answer.
5. Ties in this event will be resolved on the basis of the (correct) responses to a number of specially designated questions.
6. The team with the highest total score will be declared the winner. Second through fifteenth place winners will be determined in a similar manner.

EVENT #3 -- QUIZ SHOW

PRELIMINARY ROUND COMPETITION:
1. The Preliminary Round will be a written test consisting of 30 multiple choice questions.
2. Questions will be factual and conceptual, some involving computation.
3. Each team will be given 20 minutes to answer as many questions as possible.
4. Each team is to work together and is to submit one answer sheet.
5. No slide rules or calculators will be allowed.
6. Scratch paper and pencils will be provided and will be collected at the end of the test.

SCORING:
1. The score for this round will be determined by adding two points for every correct answer and subtracting one point for every wrong answer. An answer left blank will be given zero points.
2. The teams with the top three scores will enter the final round. Ties for third place will be resolved on the basis of the responses to a number of specially designated questions on the quiz.

FINAL ROUND COMPETITION:
1. Questions for this round will be randomly chosen.
2. Each team will be provided with a switch. The first switch activated will turn on the indicator light for that team and will block the other teams' indicators from being turned on.
3. Each question will be given verbally and the team that turns on

its indicator light will give the answer verbally.
4. Ten seconds will be allowed for an answer to be given after the indicator light is turned on. For an answer to be correct, it must be accompanied by proper units!
5. Any question not responded to in one minute will be voided.
6. This round is limited to 20 questions.

SCORING:
1. One point will be added to the score for a right answer and one will be subtracted for a wrong answer.
2. The first team to reach a score of 4 will be declared the winner and the competition will end. If after 20 questions no team has scored 4 points, the team with the highest score will be declared the winner.
3. If after 20 questions there is a tie for first place, extra questions will be given to the tied teams only until the tie is resolved.

OVERALL SCORING:
1. First, second, and third place will be awarded on the basis of placement in the Final Round.
2. Ties (2nd and 3rd) will be broken on the basis of test scores in the Preliminary Round. Other than this, Preliminary Round scores have NO EFFECT upon the awarding 1st, 2nd, or 3rd places.
3. Fourth through fifteenth places will be awarded on the basis of scores achieved in the Preliminary Round.

EVENT #4 -- FLYING MACHINE

RULES AND REQUIREMENTS:

Two separate competitions will be run: one for duration and one for accuracy. In both cases, the following rules and requirements apply:

1. Competitors will provide their own Flying Machine. One entry per team; two members per team.
2. The same Flying Machine must be used for both competitions.
3. Accuracy launches will be executed from a single competitor's hand at a target 25 m from the launch point. No forward motion of the arm or hand of the competitor is allowed during the release of the Flying Machine. Duration flights may be made from either a volleyball referee's platform or from a standing position on the gym floor.
4. There are no size, construction, or material limitations, except that the Flying Machine must have a minimum weight of 0.02 N. The use of remote control devices is prohibited.
5. Propulsion is limited to rubber bands or model airplane contest rubber which is, and must remain, aboard the Flying Machine and must provide the forward motion.
6. Practice flights will be taken before the competition begins. Each competitor will be afforded the opportunity to make two launches for scoring in each round with the best score for the round being retained for scoring purposes.

7. Modifications of the Flying Machine may take place between the accuracy and the duration phases of the competition. However, the mass must remain constant; i.e. nothing may be added to, or removed from, the Flying Machine.
8. If there is a mechanical problem, the contestant will be given three minutes to rectify it once he/she has been called to compete.

ACCURACY:
1. Each competitor will release his/her Flying Machine at a target placed on the floor 25 m from the launch point.
2. The position of the first impact with the floor is recorded. Each impact position will be spotted as it occurs for later measurement.
3. If the contestant completes two (2) flights for accuracy, the more accurate of the two will be used for scoring purposes.
4. Distances from the center of the target area to the impact positions will be measured in meters. The smallest distance from the target determines the winner.
5. The winning score is awarded 1 point with the other scores being given in accordance with the placement; i.e. second place equals 2 points; third place 3 points, etc.

DURATION:
1. The contestant has the choice of releasing the Flying Machine from either the platform or from a standing position on the gym floor.
2. Timing of a flight begins from the time the Flying Machine becomes airborne until it makes contact with any solid part of Beeghly Center (i.e. score board, bleachers, ceiling, floor, etc.).
3. The times recorded by three timers will be averaged to the nearest tenth of a second. If the contestant completes two (2) flights for duration, the better (average) time will be used for scoring purposes.
4. Greatest duration will be awarded 1 point with other scores being given in accordance with the placement; i.e. 2nd place equals 2 points, 3rd place equals 3 points, etc.

TOTAL SCORE:
1. The score is composed of the sum of the accuracy plus duration scores. The competitor with the lowest total score will be declared the winner, with the other place winners determined in the same manner.
2. Ties will be broken by the better score in the accuracy phase of the competition.

CONTESTANTS WHO ARE SCHEDULED TO PARTICIPATE IN ANOTHER EVENT BEGINNING AT 9:30 A.M. MUST COMPLETE THE FLYING MACHINE COMPETITION BY 9:25 A.M. OR HAVE AN ALTERNATE STANDING BY TO COMPLETE IT.

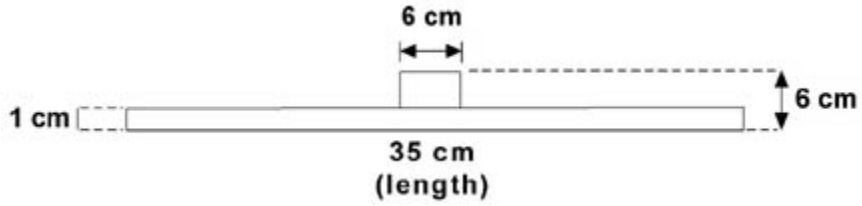
EVENT #5 -- BRIDGE BUILDING

APPARATUS:

Construction and materials must satisfy the following rules and requirements:

1. The bridge shall permit the testing block assembly pictured below to slide laterally underneath the width of the bridge without touching. (The length of the test block must pass underneath and parallel to the bridge.) The span of 35 cm between supports will be the location where the test block is placed.
2. The bridge shall be free-standing.
3. The bridge shall have an approximate level and smooth "road surface" with a minimum width of 3 cm and a minimum length of 20 cm so that a Hot Wheels type car can ride across it.
4. The bridge shall contain no element wider than 1/8" x 1/8" commercial balsa stock. Two or more single pieces, each separately qualifying, may be attached by the competitor without violating this requirement. Splitting wider balsa stock into 1/8" x 1/8" sections is NOT permitted.
5. Balsa wood and Elmer's White Glue are the only materials to be used! Bridges constructed of bass wood will be disqualified.
6. The total mass of the bridge plus the glue shall not exceed 40 grams.
7. No fastening mechanism except mechanical interlock of the balsa pieces or Elmer's White glue is allowed.
8. The bridge design shall permit the testing block assembly (see figure) to be placed on the road surface.

The width of the test block should be at least 3 cm (the minimum width of the bridge.



NOTE: Any bridge not meeting the above specifications will be automatically disqualified. It is, therefore, important that each contestant be aware of this fact and that his/her bridge be carefully checked before being entered. Once the bridge is checked in, no further adjustments will be permitted.

COMPETITION:

1. The bridge shall be placed upon a testing stand which will consist of two flat surfaces which will be level with respect to each other and separated by approximately 30 cm.
2. The contestant may choose either a single 1/2" diameter dowel rod or two 1/2" diameter dowel rods, extending beyond the sides of the bridge. The load applied to the bridge shall be suspended from either the single rod placed in slot A of the test frame or the two rods placed in slots B. (Whether one rod or two are used will be determined by the design of the entrant's bridge. If either option would work, the judge will choose the two-rod method.)
3. A plastic barrel, with an empty weight of approximately 30 lbs,

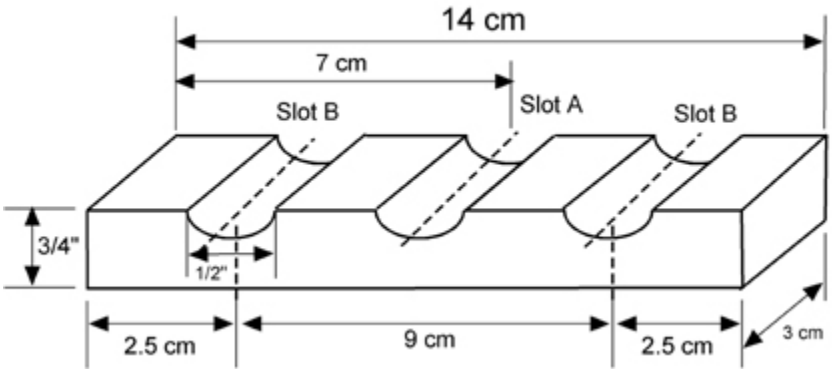
shall be suspended from the Test Frame. If the bridge does not collapse from this qualifying weight, then the official judge will begin to slowly add additional weights until the bridge collapses. (The definition of a collapse will be left SOLELY to the discretion of the judge.)

SCORING:

The bridge with the greatest ratio of

$$\frac{\text{Mass held by bridge at collapse}}{\text{Mass of bridge}}$$

is declared the winner. Second through fifteenth places will be determined in a similar manner.



EVENT #6 -- HOT WATER MAKING

PURPOSE: To heat 300 grams of water by mechanical means in such a way that the greatest change in temperature is attained in the shortest time.

A minimum rise of 5 degrees Celsius is required before a judging score will be assigned.

APPARATUS (Each team may bring one apparatus):

Each team of two members will construct one device to be brought to the competition that will, using mechanical means only, heat 300 grams of water to the highest temperature in the shortest time. "Using mechanical means only" is interpreted to mean that solar, flame, chemicals, or other direct sources of heat may not be employed.

The use of electric generators or similar conversion of mechanical energy to electrical energy is also prohibited. The heat energy must be obtained only through "mechanical means", the original energy source being the two team members. (However, the mechanical energy may be converted to heat by first producing friction, for instance.) The decision of the judge on whether a device qualifies will be final. In addition, there must be no damage done to the surroundings caused by the use of the device.

PROCEDURE:
1. Teams will be issued 300 grams of water at room temperature in a 12-oz styrofoam cup. The water must be heated through mechanical means and returned to the judges as a cup of hot water. If they wish, teams may bring their own thermometers. No additives, chemical or otherwise, to the water will be permitted. After a 3 minute set-up period, the event will begin and the time of heating and the final temperature of the hot water will be measured.

2. The maximum time allowed to heat the water will be 15 minutes.

SCORING:
1. Two watches will be started when the contestant begins to pour the water into the EMPTY reservoir. The first watch will stop when the cup has been refilled after the heating process and the competitor has said "stop." The cup will be adjusted to 300 grams of water by adding room temperature water. The final temperature will then be measured.

2. A minimum rise of 5 degrees Celsius in tempterature is required before a judging score will be assigned.

3. Should the minimum temperature not be achieved, the contestants may choose to again place the water in their container and continue heating a second time. The second watch will stop when the cup has been refilled after the heating process and the competitor has said "stop." The cub will be adjusted to 300 grams of water by adding room temperature water. The final temperature will then be measured. In this case, the time used to calculate the "Event Score" will be the cumulative time read on the second watch.

4. The maximum "Team Score" of 15 points will be awarded to the team with the highest "Event Score."

5. Second through fifteenth places will be awarded on the basis of the relative "Event Scores."

EVENT #7 - MYSTERY PROBLEM

The theme for 2009 is: **Geometric Optics**

EVENT #8 -- MOUSETRAP RACER

PURPOSE: To transport a 500 gm slotted mass the greatest horizontal displacement using as the sole source of propulsion the stored potential energy of a standard commercial mousetrap.

APPARATUS:
1. Each team may enter one (1) mousetrap-powered vehicle.
2. The vehicle shall have a minimum of three (3) functioning

wheels, which must be in contact with the floor at all times.
3. No weight limit is imposed on the vehicle produced.
4. The only power source of the vehicle shall be a standard Victor mousetrap with spring and bow attached to the base as originally manufactured. The mousetrap base may be altered. The mousetrap must remain part of the vehicle body at all times. Flexible devices, such as fiberglass fishing rods, that add potential energy are prohibited.
5. The mousetrap spring must have a pull of 600 grams or less. The vehicle will be held with the base of the mousetrap in a vertical position; a 600 gram mass will be attached to the bow; if the bow assumes a horizontal or lower position, the vehicle qualifies for the competition.
6. No "rubber" bands/tubing may be used to add potential energy.
7. The 500 gm slotted mass to be transported must remain aboard the vehicle at all times and will be provided by the judges on the day of the competition. It must be positioned in such a way so as not to add gravitational potential energy to the system!
8. The slotted mass to be transported is 4 cm high and has a cross-sectional area as shown to scale below.

(Note: because of the differences in browsers, the mass cannot be guaranteed to be shown to scale. It is a standard slotted mass found in any physics lab and is the same as used in previous years.)

COMPETITION:
1. The vehicle shall be set by the contestant and placed at the starting point of the competition area. At a sign from the judge, it shall be released without forward directed impulse.
2. In the event that the vehicle is not self-starting, the judge, but not the contestant, may blow lightly on the vehicle at whatever angle is stipulated by the contestant. Only two such attempts to start the vehicle shall be allowed.
3. The surface of competition shall be a wooden gymnasium floor.
4. Vehicles running into a natural barrier of the course, such as a wall, may be rotated by the judge to a new orientation for a continuation of the motion.
5. Each vehicle will be allowed two (2) trials to determine the best distance. The distance will be measured along a straight line from the starting point to the stopping point.

SCORING:
1. The vehicle which travels the greatest horizontal displacement between the starting point and the stopping point will be declared the winner.
2. In case of a tie, the winner will be determined by the lightness of the vehicle; i.e. the lighter racer wins.
3. Second through fifteenth places will be determined in a similar manner.

EVENT #9 -- PING-PONG BALL LAUNCH

PURPOSE: To obtain the highest possible score while launching a

ping-pong ball via a catapult from three (3) different specified distances and having it land on/in a circular target.

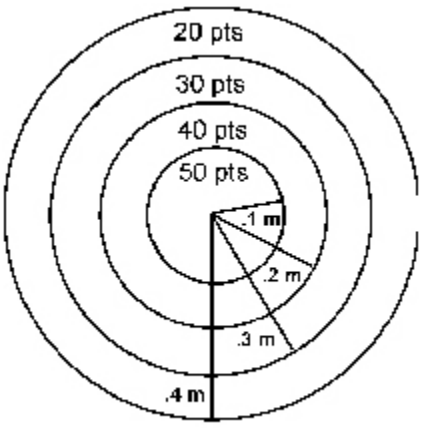
ENTRIES: Each team will be limited to one entry. The same device must be used for all three (3) launch distances, although it may be modified for the different launch distances. Each team will consist of one official competitor who may have up to two (2) assistants depending on the needs associated with the individual catapult.

APPARATUS:
1. The catapult will have a base (wheels, rubber base, etc.) that will not scuff the gym floor.
2. There is no weight limit on the catapult.
3. When in its ready-to-launch position for the 2 meter competition, the catapult must completely fit into a box 30 cm on a side (i.e. 30 cm x 30 cm x 30 cm).
4. The catapult itself must be made entirely of non-metallic materials; the only exception will be the use of metal fasteners (hook eyes, rings, angle braces, etc.). Every effort should be made, however, to construct the entire apparatus from cloth, wood, rubber, latex, canvas, tape, glue, and other non-metallic materials. NO METAL HINGES OR METAL RODS WILL BE PERMITTED!
5. The catapult must be self-sufficient (i.e. no electric motors, human help, compressors, etc.). A release mechanism (i.e. a trigger) MUST be utilized to launch the ball. The trigger must be able to hold the launch mechanism in place, ie. the student must be able to set the trigger and walk away from the launcher without having it release until it is triggered to release. Determination on eligibility of apparatus will be SOLELY to the discretion of the judges.
6. The target will consist of a series of concentric circles, as illustrated.
7. The ping-pong balls used will be of a good quality and will be provided by the judges at the time of the competition. If you prefer, you may bring your own good quality ping pong balls.

COMPETITION:
1. Each competing team will launch four ping-pong balls at the horizontal target on the floor at each of 3 distances.
2. The distances will be 2 meters, 4 meters, and 7 meters, as measured from the center of the target to the shooting box.
3. The catapult may be placed anywhere within the shooting box at the three designated distances. The box will be a 0.5 m square, and the base of the catapult must fit inside it.
4. The point of initial contact between the ball and the target will be considered for scoring purposes.
5. The score for each distance will be determined by the three (3) balls yielding the highest score. The score yielded by the 4th ball will only be used to break ties.
6. The final score will be arrived at by adding up the scores from each of the 3 phases of the competition. The team with the highest score will be the declared the winner. Second through fifteenth places will be determined in a similar manner.

MECHANICS AND SCORING:
1. A competitor must have all four launches completed for each distance within 5 minutes of the start of each phase of the competition.
2. Launches that are not made by the end of the 5 minutes time limit will be recorded as 0 points.
3. There will be a three (3) minute time period allotted for adjustments from 2 m to 4 m distance and from 4 m to 7 m distance. No adjustments may be made prior to this three (3) minute segment of time nor may any recorded launches be made during this adjustment period. (*Practices may be taken but they will not count.*)
4. Any ball that is launched during the three 5-minute competition periods will be counted for scoring purposes and any launched ball will be worth a minimum of 10 points.
5. Scoring beyond the 10 points may be achieved only by balls which initially hit the target (not the floor). A ball must land completely in an area to receive a score. Any ball partially in each of 2 areas will receive the LESSER of the two scores.

TIE BREAKERS:
1. 4th ball score at 7 m
2. 4th ball score at 4 m
3. 4th ball score at 2 m
4. Number of 50 point shots at 7 m
5. Number of 40 point shots at 7 m
6. Number of 40 point shots at 7 m



Sample Target

EVENT #10 -- PHYSICS PHLOATER

APPARATUS:
1. The raceway consists of 4-inch PVC pipe, cut in half lengthwise, approximately 10 feet long. It will be filled with water to a depth of 3.5 cm.
2. The Phloater may be constructed of any material that fits and remains inside the pipe and floats freely during the entire run. The Phloater must have a minimum mass of at least 75 grams and its length shall not exceed 30 cm.
3. The Phloater must have a 1/8-inch dowl rod mast that extends at least 15 cm above the trough and remains at that height above the trough for the entire race. The mast will be used for timing purposes. (See #3 below.)
4. The Phloater must have propulsion provided by a rubber band(s) or contest rubber and the system must remain on board the Phloater

throughout the run. ***Clarification: Boats must be air driven; no water propellers.***

COMPETITION:
1. Each school may enter up to two (2) Phloaters, which must be submitted at time of registration. The Phloater(s) will be returned to the competitor at the time of competition.
2. Each Phloater will have the opportunity for two runs along the water course, which is 1.5 m in length.
3. The race will be timed using photogates and laser pointers. The photogates and pointers will be arranged 1.5 meters apart and 5 cm to each side of the trough (photogate on one side and laser pointer on the other).
4. The contestant will place the Phloater at the starting line when the judge calls for the school's representative(s). The mast must be within 2 cm of the first photogate and proceed forward when released. When the judge says "GO," the contestant will release the Phloater. The timing will commence when the mast breaks the first beam and stop when it breaks the second beam.

SCORING:
1. The shortest (non-zero) time of each Phloater's two runs will be recorded for the competition.
2. Ties will be broken by the better time recorded on the 2nd race trial.

EVENT #11 -- PHYSICS HANG-UPS

OBJECT: To afford students an opportunity to express their knowledge of physics in a creative, artistic, or humorous manner.

TEAM: Entrants (students) must be or have been enrolled in Physics. Entries in this event will be limited to one (1) poster per student and up to two (2) posters per school. If more than one poster is entered by a school, the one with the higher number of points will count toward the total team score. Students must be present at the time of the judging to answer questions.

RULES:
1. The theme for this year's contest is: **400 Years of the Telescope**
2. The poster board used must be 18" x 22" in size.
3. Any medium except chalk or pastel may be used.
4. No part of the poster may be thicker than 1 cm.

COMPETITION:
1. Posters will be judged on appearance, appropriateness, and execution. A good poster should present its topic in a simple, visual manner.
2. A panel of two judges will evaluate each poster. This part of the competition will be limited to two minutes. The poster must speak for itself.
3. Posters must be in the west corridor (to the left of the Main Gym) no later than 10 a.m. Posters must have holes punched in the upper right- and left-hand corners so they can be displayed by

suspending them with clips.
4. The posters will remain displayed until 1 p.m. after which they must be removed by the contestant or his/her designee.
5. Each poster must be labeled on the front with the name of the artist, the name of the school and then if it is the "A" (first) poster or "B" (second) poster from that school.

JUDGING:
Judging will be based on the following point system:

Physics - 40 points
Creativity and originality - 30 points
Workmanship (construction) - 30 points

SCORING:
The poster that receives the highest number of points will be declared the winner. Second through fifteenth places will be determined in a similar manner.

EVENT #12 - MAKING MUSIC
Original Musical Instruments

PURPOSE:
In this event we wish to encourage students to explore the production and collection of sounds in an artistically creative as well as scientific manner.

TEAM:
A group of no more than three students will construct their own musical instruments and perform a specific required song. The song for the 2009 competition is *Twinkle, Twinkle Little Star*. This is a simple, basic tune. Feel free to be creative in your style (traditional, classical, rock, jazz, etc.) and instrumentation. For examples, check out some of the postings on YouTube:
http://www.youtube.com/watch?v=im_tJLeo2qU&feature=related
Only the original musical instruments may be used in the performance.

RULES:
1. Each team will have one presentation, to be held immediately following the Egg Drop competition in the gymnasium. Adjudication will be done at that time.

2. Students will perform their rendition only on the instruments they have constructed.

<>3. No commercially manufactured conventional musical instruments (or any part thereof), synthesizers, or digital samplers can be used. ***Air compressed using mechanical devices may not be used; the contestant(s) lungs are the only source of air.***

4. The following written explanation must be included. Three copies for the adjudicators must be turned in at the registration table upon arrival. Explanation as follows:

> Required is a one-page, double-spaced explanation of the technical aspects of the production of the ***required*** music, including the applicable physics. An additional page of diagrams and/or drawings is required.

ADJUDICATION:
Adjudication will be based on the construction of the instrument(s), the musicality of the performance of the required song and the explanation of the physics involved in making the project. An oral explanation must be made. Adjudicators may ask questions regarding the project.

SCORING:

30% Originality of musical instruments
30% Musicality of the performance
20% Written technical explanation
20% Oral technical explanation

Updated: 01/30/09