



Saturday, February 24, 2024 - 8:00 am -3:00 pm

2024 Information and Rules

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GENERAL INFORMATION

- YSU Physics Olympics will be held **Saturday, February 24th 2024** from 8:00 am -3:00 pm in the gymnasiums in Stambaugh Stadium (GPS address: 577 Fifth Ave., Youngstown, OH).
- For the first time students in **grades 6-8 will be welcome to compete against fellow middle school students in the following events:**
 - **House of Cards, Bridge Building, Egg Drop, Soda Straw Arm, Physics Hang-ups**
- Grades 9-12 will be eligible to compete in all events.
- Participants will be able to drop their entries off starting at 7:00 am, using the north facing Ticket Window entrance across from McDonalds if needed.
- Parking is available for \$5.00 in the M70 lot on Fifth Ave (Next to McDonalds).
- If you are bringing a school bus, parking information will be forwarded.
- For questions and information, contact the Physics Olympics coordinator, Sarah Eisnaugle-Bika via email at Sleisnaugle@ysu.edu or 330-553-8551, or Jill Mogg in the Department of Physics & Astronomy, at jimmogg@ysu.edu or by phone at 330-941-3616.
- Visit the Physics Olympics Facebook page or the YSU Physics Olympics page at <http://www.ysu.edu/physics-olympics> for updates and online registration forms
- There is a \$20 registration fee per school. Checks/PO's may be made payable to "YSU Physics Olympics"

EVENT #1 – HOT WATER MAKING

(Open to teams in Grades 9-12)

TEAM: A team can have up to TWO (2) members

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 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 temperature 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 cup 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 #2 – FLYING MACHINE

(Open to teams in Grades 9-12)

TEAM: A team can have up to TWO (2) members

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.
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 may 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. 2022 Physics Olympics Rules - Page 5 of 15
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 the gymnasium (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 accord

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. NOTE: 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.

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EVENT #3 – HOUSE OF CARDS

(Open to ALL participants)

TEAM: A team consists of two (2) members.

OBJECT: To construct a free-standing structure of maximum height within a time limit of 30 minutes

APPARATUS:

1. Each team will be supplied with 100 3 × 5 lined file cards and a 1-m length of transparent tape on arrival at the contest site.
2. Meter sticks, straight edges and scissors will be available at the construction site. The use of tape dispensers will not be allowed.

COMPETITION:

1. Each team may have only one entry.
2. The cards may be cut into pieces and reassembled as desired. The cards may also be rolled, folded, or slit.
3. The tape is to be used **ONLY** to fasten the parts of the structure together. It may not be used to attach the structure to the floor or to any other object.
4. Each team must complete the construction of its structure within 30 minutes. The height will be measured only once and at a time requested by the team.
5. Height will be determined by measuring the perpendicular distance from the highest point of the structure to the floor.
6. After measurement, a structure shall be considered free-standing if it remains self-supporting for more than 10 seconds, and no apparent change in height has occurred. If some change has been detected, then a second measurement will be made with the lesser of the two heights becoming the official height.

SCORING:

1. The tallest free-standing structure constructed within the allotted time will determine first place
2. All other award placements will be determined in a similar manner.

EVENT #4 – BRIDGE BUILDING

(Open to ALL participants)

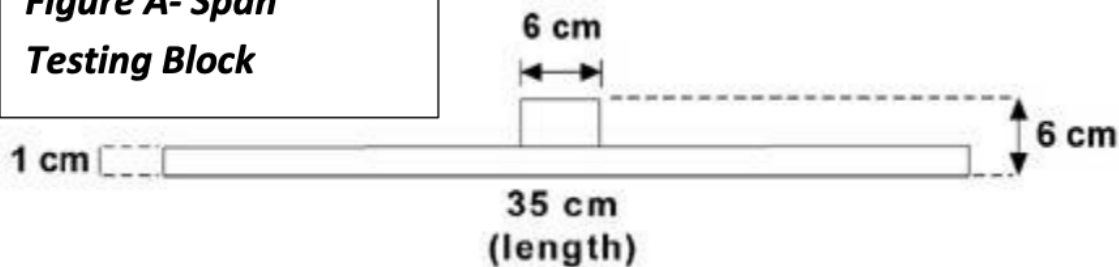
TEAM: One (1) person per team; up to two (2) entries per school. If more than one bridge is entered by a school, the bridge with the higher number of points will count toward the team score. Team members will be responsible for writing the school name (may be abbreviated) and number on the bridge. For example: "Boardman #1"

APPARATUS: Construction and materials must satisfy the following rules and requirements:

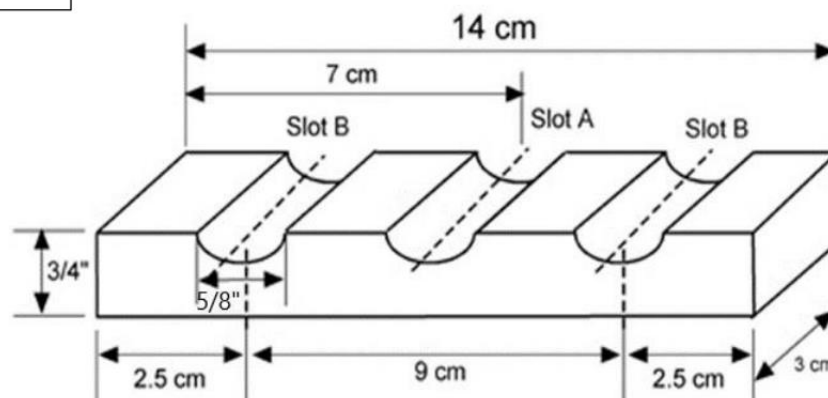
1. The bridge shall permit the span testing block pictured (Figure A – below) to slide laterally underneath the width of the bridge without touching. (The length of the test block must pass underneath and parallel to the bridge.) The span of 35 cm between supports, measured on the inside of the bridge legs, 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 40grams.
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 B) 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.

**Figure A- Span
Testing Block**



**Figure B- Testing
Block Assembly**



COMPETITION:

1. The bridge shall be placed upon a testing stand which will consist of a flat level surface, with an opening of 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 Figure A- Span Testing Block Figure B- Testing Block Assembly 2022 Physics Olympics Rules - Page 7 of 15 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 water to the barrel until the bridge collapses. The total breaking weight will be measured after the bridge has collapsed. (The definition of a collapse will be left SOLELY to the discretion of the judge.)

SCORING: The bridge with the greatest ratio of **Mass held by the bridge at collapse/Mass of bridge** is declared the winner. Second through fifteenth places will be determined in a similar manner.

EVENT #5 – SODA STRAW ARM

(Open to ALL participants)

TEAM: A team consists of 2-3 members.

SODA STRAW ARM: Each team will be given 15 jumbo plastic, clear straws, 10 straight pins and one #1 paper clip. The straws used in the competition will be 7¾" or 10" straws. Straws will be provided for the actual competition only. No straws will be provided for event preparation. The purpose of the competition is, with only the above materials, to construct the longest arm from their own team design that will support a 50-gram mass. Construction time will be 20 minutes with testing by the team allowed during the construction. The paper clip, bent to an "S" shape, is to be used only for attaching the 50-gram mass. It must be attached by looping it over a single straw or pin. It may not be used in any way to strengthen or help construct the arm.

1. Students are required to bring and show the judges a sketch of their design prior to the competition to guide their construction. No physical models will be allowed at the competition.
2. Straws, pins and the mass will be provided at the competition. The mass will be attached to a string (approximately 30-cm from the paper clip to the top of the mass). Scissors and pliers will be allowed as tools but they will NOT be provided.
3. If students wish to cut pins, they must bring and wear chemical splash goggles and gloves and move to the "pin cutting station" to complete this process. Goggles and gloves will NOT be provided. Students will not be allowed to cut pins without wearing goggles and gloves. If no goggles are worn, then the pins cannot be cut. If pins are cut without the use of goggles and gloves, then the team will be disqualified and will not complete this problem in the competition.
4. All construction must be done during one 20-minute time period at the competition site. If pins bend or break during construction, they will not be replaced. At the end of the 20 minute period all arms will be labeled and placed on the judge's second table. The team members will pick up the arm only when they are called to compete. No modifications are allowed after the 20-minute construction period. This prohibition includes replacing straws or pins, which have pulled loose from the arm.
5. The arm apparatus must be in contact with (not secured to) the top surface only of the table. e. The arm must support the mass above the floor for 10 seconds without any straws "crimping". Crimping is a fold line across the straw and will be allowed in the original construction before testing.
6. A team member is responsible for holding the straw arm and sliding it out from the edge of the table to the desired position. This person may not touch any part of the apparatus that extends beyond the table once timing has begun. Once the straw arm is in the selected position and tension has been supplied by the 50-gram mass, the 10-second period begins, and manipulation of the arm by the holder must stop.
7. The distance will be measured along a horizontal line perpendicular to the table edge from the point directly above the point of attachment of the weight. The distance to be recorded will be the distance at the end of the 10-second time period. h. If the arm design is such that the arm end is higher than the tabletop, the 30 cm string must extend below the top of the table so the judge can accurately measure the length using a meter stick at table-top height.

THE COMPETITION:

One of the team members will hold the arm in the desired test position against the tabletop with no part of the team member's body extending beyond the test edge of the table and with both palms touching the tabletop. No other part of the team members' body may touch the arm or be attached to it. The other team member will attach the weight by placing the loop of the string attached to the 50-gram mass over the hook end of the paper clip. As soon as the team member hooks the string and immediately removes his/her hand from the string, the 10-second period will begin. This team member may not touch the arm, string, or mass during the 10 second time period. During this time the holding team member may not manipulate the arm. At the end of the 10-second time period, the judge will measure the length of the soda straw arm. Each team whose arm successfully holds the 50-gram mass for ten seconds will be immediately given a second trial. No changes may be made to the arm except for desired repositioning on the tabletop. The winner is the team with the arm having the longest recorded distance, which held the mass successfully for 10 seconds.

EVENT #6 – PING-PONG BALL LAUNCH

(Open to teams in Grades 9-12)

TEAM: Each team will consist of one (1) official competitor who may have up to two (2) assistants, depending on the needs associated with the individual catapult. Up to three (3) awards will be awarded, however only one prize will be awarded.

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.

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 each 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, i.e., 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 of 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 for 2022 will be .75 meters, 2.5 meters, and 6 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 1.5 m to 4 m distance and from 4 m to 6 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 6 m
2. 4th ball score at 4 m
3. 4th ball score at 1.5 m
4. Number of 50 point shots at 6 m
5. Number of 40 point shots at 4 m
6. Number of 40 point shots at 1.5 m

EVENT #9 – PHYSICS PHLOATER

Boats must be air driven; no water propellers.

(Open to teams in Grades 9-12)

TEAM: Two entries per school no more than two students per entry. A maximum of 2 Phloaters per school, to be submitted at time of registration. The Phloater(s) will be returned to the competitor at the time of competition.

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 and width shall not exceed 30 cm.
3. The Phloater must have a 1/8-inch dowel 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 and can be no higher than 48 cm. (See #3 below.)
4. The Phloater must have propulsion provided by a rubber band(s) and the system must remain on board the Phloater throughout the run.

COMPETITION:

1. Each Phloater will have the opportunity for two runs along the water course, which is 1.5 m in length.
2. 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).
3. The contestant will place the Phloater at the starting line. The mast must be within 2 cm of the first photogate (no higher than 48 cm) 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 team competition score.
2. Ties will be broken by the better time recorded on the 2nd race trial.

EVENT #9 – PHYSICS HANG-UPS

(Open to ALL participants)

TEAM: Entrants (students) must be or have been enrolled in Physics. Entries 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.

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

RULES:

1. The theme for the 2024 contest is: Physics of Rollercoasters
2. The poster **MUST** include the equation.
3. The poster board used must be 18" x 22" in size.
4. Any medium except chalk or pastel may be used.
5. 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 properly hung up 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 if it is the "A" (first) poster or "B" (second) poster from that school.

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

1. Physics - 40 points
2. Creativity and originality - 30 points
3. 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 #9 – MAKING MUSIC (Original Musical Instruments)

(Open to teams in Grades 9-12)

TEAM: A group of no more than three (3) students will construct their own musical instruments and perform a specific required song.

PURPOSE: To encourage students to explore the production and collection of sounds in an artistically creative and scientific manner.

SONG: The song for the 2024 competition will be “Can't Stop The Feeling” by Justin Timberlake
<https://musescore.com/sheetmusic?text=cant%20stop%20the%20feeling>

RULES:

1. Each team will have one presentation.
2. Students will perform their rendition only on the instruments they have constructed.
3. All music will be produced OUTSIDE of the human body (no humming!)
4. 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 contestants' lungs are the only source of air.
5. 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:
6. Required is a one-page, double-spaced explanation (no larger than 12 point font) 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 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:

1. 30% Originality of musical instruments
2. 30% Musicality of the performance
3. 20% Written technical explanation
4. 20% Oral technical explanation

EVENT #10 – EGG DROP

(Open to ALL participants)

TEAM: One team (entry) per school, containing up to (2) members.

OBJECT: To construct a container of an 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 standard copy paper. Each team will be provided with 10 sheets of 8-1/2" x 11" copy 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 14 meters (This is 3 ½ flights up the interior stairwell of Stambaugh Stadium.)
8. The egg must survive intact (not cracked). The decision of the judge is final.

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.

ADDITIONAL NOTES:

1. The official height for the Egg Drop is 14 meters - three and half flights up the Stambaugh stadium stairs.
2. The landing can be easily accessed through the Michael & Mary Jo Fagert Lobby (north lobby by Hot Water Making Event), or the elevator located there.
3. To reach the judges one flight of ten stairs will need to be climbed.
4. The apparatus and egg will land in the basement level.
5. The drop area is in between the walls and the measurements are 1 meter x 5 meters x 14 meters.