STORM THE CASTLE

1. **DESCRIPTION**: Prior to the tournament, teams design, construct, and calibrate a device that uses only the energy of a falling counterweight to launch a projectile as far and accurately as possible.

   A TEAM OF UP TO: 2 **EYE PROTECTION**: #5 **IMPOUND:** Yes **APPROX. TIME:** 15 Minutes

2. **EVENT PARAMETERS**:
   a. Prior to the day of the competition, the team must calibrate their devices by preparing up to 5 graphs showing the mass of various projectiles or counterweights vs. distance. If they are hand drawn, they must be on graph paper. All graphs must be properly labeled and marked to identify the team submitting them.
      i. Teams may be required to submit their graphs prior to the tournament as requested by the supervisor.
      ii. Teams must have a duplicate set to use during competition, as those submitted may not be returned.
      iii. Students must be prepared to answer questions about the data collection and how the graphs are used.
   b. Teams may also submit an example calculation page showing how to use the graphs to position the target for a hypothetical counterweight and projectile.
   c. The team's device and any supplies (tools, notes, copies of graphs, etc.) must be impounded before the start of the event. Appeals by teams will not be processed after they remove their device from the competition area unless it has been released by the appeals committee.
   d. All teams must use the same projectiles, counterweight, and target provided by the judges. The mass of the counterweight and projectiles will not be announced until all of the devices have been impounded.
   e. Competitors must wear eye protection rated ANSI Z87+ during set-up, testing, and launching. Teams without proper eye protection must not be allowed to compete and are scored as a no-show.
   f. Event supervisors may disqualify any apparatus that is operated in an unsafe manner.
3. **CONSTRUCTION**:
   a. The entire device, including the projectiles and counterweight must fit in a 75 cm cube when in the ready-to-fire position.
   b. The triggering device is not considered part of the device. It must extend out of the launch area and does not need to return to the launch area after launch. Battery triggered devices are allowed; radio controlled devices are not. The triggering device must not pose a danger to anyone due to flying parts or excessive movement outside of launch area.
   c. The device must be constructed to accommodate the counterweight and the projectiles. Neither the counterweight nor the projectiles may be modified.
   d. The counterweight will consist of a 1 to 3 kg mass with a hook on top. The hook and counterweight together will fit inside a 15 cm cube. If the hook is used to attach the counterweight, the attaching point on the team's device must be made from material no more than 6.5 mm thick with a hole at least 9 mm in diameter. The edge of the hole must be no more than 1 cm from the edge of the material.
   e. Projectiles will have a mass of 20 to 60 grams and will be approximately spherical with a diameter not exceeding 6 cm. Dangerous projectiles must be avoided. If multiple projectiles are provided, they will be similar in size, shape, and mass.
   f. The device, without the counterweight and projectile, must not contribute energy to the launch. Example violations include: the axis upon which the firing arm rotates drops during launch, the center of gravity of the unloaded device drops during a launch motion, the triggering process provides momentum to the launch, a form of potential energy (compressed or stretched elastic solids, compressed air, etc.) is used. Without a counterweight and projectile, the launch arm must not make a launch motion when released from any position before the point where the projectile is released. Allowable types of devices include, but are not limited to, counterweight and floating-arm trebuchets, subject to these rules.
4. **THE COMPETITION:**
   a. Only competitors, the Event Supervisor, and officials are allowed in the impound and competition areas while teams are competing. Once teams enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing.
   b. When instructed by the event supervisors**,** teams must place their device anywhere within a marked perimeter of a 2 m by 2 m square designated "the Launch Area" and must not anchor it to the ground.
   c. The use of AC powered electrical equipment to setup and operate the device is not allowed.
   d. Except for the triggering mechanism, no part of the device and counterweight may extend out of the Launch Area before it is triggered or after the launch motion is complete. Any part of the device or counterweight that extends out of the launch area during the launch must return to rest within the Launch Area without assistance.
   e. The target must be an open topped container with a minimum dimension of 20 cm x 20 cm x 20 cm.

i. Before the first launch, the team must announce the position of the target (Target Distance) in whole meters. The event supervisors must set the target so that two sides of the target are parallel with a straight line from the center of the Launch Area to the center of the target.
ii. If they hit the target, the team may request it moved to a new Target Distance (in whole meters).
iii. Event supervisors must indicate each projectile's first point of impact. After each launch the event supervisor will indicate when the competitors may approach the target to make measurements to calibrate their device, which is included in the team's 5 mins. Competitors may not touch the target.

f. The device may be moved anywhere within the Launch Area between launches.
g. During the launch, competitors may not touch or hold the device, or be in the launch area or the area in front of the line that marks the front edge of the launch area. They may touch only the part of the triggering device that extends outside of the launch area.
h. Teams have 5 minutes to make 3 launches. No practice shots may be made. They must give ample warning to the event supervisors and spectators prior to each launch. It will not count as a launch if the competitors attempt to initiate a launch and the device does not go through a launch motion.
i. Time the event supervisors spend moving the target or measuring the distances to the projectiles does not count against the team's 5 minutes.
j. Event supervisors will be responsible for retrieving projectiles and returning them to the team between each launch if less than 3 projectiles are initially provided to the team.
k. In the event of a rule violation or penalty, the event supervisor must stop the timer and explain the reason for the violation or penalty. The team may continue to compete after the clock has been restarted.
l. Devices may be modified in accordance with all rules while the clock is running in order to make successful launches. Only the tools and supplies impounded may be used during competition.
m. If a part of the device does not return to within the Launch Area on its own, the device may be repaired / repositioned and subsequent launches scored normally.

5. **SCORING**: High score wins
   a. All measurements will be made and recorded in meters to the nearest 0.01 meter.
   b. The Launch Score (LS) for each launch will be: LS = TD – A + B
      i. The Target Distance (TD) is the distance requested by the competitors and is measured from the center of the front of the launch area to the center of the target.
      ii. The Accuracy Score (A) distance from the projectile's point of first impact to the target center.
      iii. The Bonus (B) is 0.1 x TD if the projectile at first impact lands in and stays in the target.
      iv. If the projectile hits the target on first impact the Accuracy Score will be 0.
      v. If any part of the device leaves the Launch Area and does not return, the LS will be 0.
      vi. If the LS is calculated to be less than 0, it will be set to 0 for final scoring purposes.
   c. One of the submitted graphs, selected by the event supervisor, will be scored as follows:
      i. Partial credit may be given. The max Graph Score (GS) possible is 12 points.
      ii. 2 points if labeled with school and student's names.
      iii. 2 points for appropriate title of graph and X and Y-axis labels.
      iv. 2 points for appropriate units and axis increments.
      v. 1 point for each graph turned in (up to 5 total).
      vi. 1 point for an example calculation page turned in.
   d. Penalties: A 3 point penalty each time any of the following occurs:
      i. A competitor is warned for not correctly wearing proper eye-protection.
      ii. A competitor is in the Launch Area when the launch is triggered.
      iii. The device goes through an unintentional launch motion.
      iv. No warning is given prior to a launch.
   e. The Final Score will be: FINAL SCORE = Sum of 2 Best LS + GS – Penalties.
   f. Teams will be ranked by score in tiers based upon:
      i. Tier 1: Teams with no violations.
      ii. Tier 2: Teams with Competition violations.
      iii. Tier 3: Teams with Construction, Competition and Construction violations, or missed impound.
   g. Tie breakers: 1st : Best Launch Score; 2nd : Second best Launch Score; 3rd : Third best Launch Score.

Scoring Example: Graph Score (GS) = 10.5 pts; Penalties = 3 pts
Launch 1: Target Distance (TD) = 14.00 m; Accuracy (A) = 1.43 m; Score (LS1) = 14.00 – 1.43 = 12.57
Launch 2: TD = 14.00 m; A = 0.00 m; LS2 = 14.00 – 0.00 + (0.1 x 14.00) = 15.40
Launch 3: Team requested a new TD = 20.00 m; A = 2.78 m; LS3 = 20.00 – 2.78 = 17.22
FINAL SCORE = LS2 + LS3 + GS – P = 15.40 + 17.22 + 10.5 - 3 = 40.12 points

Recommended Resources: All reference and training resources including the **Storm the Castle DVD** are available on the Official Science Olympiad Store or Website at http://www.soinc.org