



# CATAPULT DESIGN

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## OVERVIEW

Participants design and produce a working catapult, within specified guidelines, that is adjustable and propels hollow plastic practice golf balls (weighing about 14.5 grams each) at a scoring target between 15' and 25' away.

## ELIGIBILITY

Participants are limited to three (3) teams of up to four (4) individuals per state.

## TIME LIMITS

- A. Entries must be started and completed during the current school year.
- B. The catapult and design portfolio must be picked up at the designated time at the conclusion of the event.

## ATTIRE

TSA competition attire, as described in the National TSA Dress Code section of this guide, is required.

## PROCEDURE

- A. Participants check in their entries at the time and place stated in the conference program.
- B. Catapults are inspected by evaluators to determine among other things, safety. Catapults that meet all Go/No-Go regulations will be approved for the performance stage of the event. Any unsafe devices will be disqualified. (Unsafe catapults include those with parts that detach during operation or those with a dangerous rotation or throwing motion, either of which could cause harm or damage.) Judges will make a final determination about the operational safety of a catapult.
- C. If an entry's catapult is approved for the performance stage of the event, the entry's design portfolio will be evaluated.
- D. A time sheet will be provided for sign up at check-in.

- E. Students must be present for the performance stage of the event.
- F. Teams will receive a bucket of three (3)-dozen hollow plastic practice golf balls (each weighing approximately 14.5 grams) for the performance stage.
- G. Students must bring and wear safety glasses for this stage of the event.
- H. One (1) team member will use a 25' tape measure for measuring and recording the distance from the catapult to the target as it is set for the given test day.
- I. The team will be given five (5) minutes to adjust its catapult for accuracy to that distance.
- J. Teams will position their catapult on the "firing line" and wait for the command to fire.
- K. Multiple teams with different colored hollow plastic practice golf balls will launch at the same time.
- L. When teams receive their bucket and the fire command is given, they will have one (1) minute to launch as many hollow plastic practice golf balls as possible to accumulate as many points as possible in the net. Each team must cease firing at one (1) minute. No shots made after time has been called will count.

- M. The center of the scoring net (red circle) will be approximately 15' from the launching area. The scoring net will consist of a golf chipping target and three (3) color-coded scoring sections. The red center target is 10" in diameter, the green is 25" in diameter, and the blue target is 40" in diameter.



- N. Scoring is as follows: red target, 5 points; green target, 2 points; blue target, 1 point.
- O. Hollow plastic practice golf balls must enter the target on the fly and be fully in the scoring net to score points. No points will be earned for bounced-in or half-in/half-out hollow plastic practice golf balls.
- P. Ties will be broken as follows: 1) the team with the highest score and least amount of hollow plastic practice golf balls in the target, and/or 2) the team with the shortest time recorded to score the most points.



- Q. Final ranking will be determined from points earned 1) for the design portfolio and 2) the catapult's performance.
- R. Lack of catapult compliance may result in disqualification.
- S. Team members must collect all hollow plastic practice golf balls once judges complete recording points and before leaving the event area.

**It is essential that students and advisors routinely check the TSA website ([www.tsaweb.org](http://www.tsaweb.org)) for updated information about TSA general rules and competitive event guidelines. This information can be found on the website under Competitions/ Competition Updates. When students participate in any TSA competitive event, they are responsible for knowing of all updates, changes, and clarifications related to that event.**

## REGULATIONS

- A. Each team must record its research and development process—from inception through testing and modification—to the performance stage for competition. This documentation should be submitted as a design portfolio, complete with sketches, pictures, and descriptions of the processes, successes, and failures related to the designed catapult.
- B. Documentation materials (comprising the "design portfolio") are required and should be secured in a clear front report cover. The report cover must include the following single-sided, 8½" x 11" pages, in this order:
  1. Title page with the event title, the conference city and state, the year, and the team/chapter ID number; one (1) page
  2. Table of contents
  3. Materials list; one (1) page
  4. Details of the research and inspiration to help determine the design for a catapult
  5. A design log (that includes testing and adjustment notes) from the start date to the present; pages as needed
  6. Sketches and pictures of the design process; pages as needed
- C. Participants must bring and wear safety goggles during the performance stage of the event.
- D. Teams must provide their own tape measure (at least 25' length).
- E. The catapult may be no larger than 2' tall x 2' long x 1.5' wide.
- F. The base of the catapult should accommodate the provided ballast. The ballast will be one (1) 50-pound bag of playground sand, provided by TSA on site.



- G. The catapult must operate completely within the given area; the launch arm may extend beyond the front of the catapult only while launching.
- H. The catapult may have any type of spring mechanism to power the arm, but all parts must be contained within the 2' tall x 2' long x 1.5' wide maximum footprint prior to launch.
- I. The catapult's total weight must not exceed fifteen (15) pounds.
- J. All parts of the catapult must initiate behind the launch line, but parts may extend over the line during and after the last launch.
- K. The catapult cannot have wheels.
- L. The catapult must be made entirely from PVC pipe, with the exception of the launch mechanism, firing mechanism, fasteners, and safety items. These items may be wood or metal and must be constructed in a safe way, so as not to damage the device, the testing area, or cause harm to others.
- M. The following may not be used:
  - 1. Glass
  - 2. Flammable, corrosive, or explosive materials
  - 3. Compounds that produce odors or gases
- N. The catapult must have at least a five (5)-foot pull cord to launch from a safe distance.
- O. When the catapult is on display or not in the performance stage, it must be fully disabled and unable to be readied for firing.
- P. Catapult Go or No-Go Compliance

**A catapult that receives a "No" answer to any of the requirements below will not advance to the performance stage of the event.**

- 1. Does the team have safety goggles? . . . . . (Yes/No)
- 2. Can the catapult be weighed down with a sand bag? . . . . . (Yes/No)
- 3. Is the catapult within the size specifications? . . . . . (Yes/No)
- 4. Is the catapult built with the correct materials? . . . . . (Yes/No)
- 5. Does the catapult launch with a pull cord? . . . . . (Yes/No)
- 6. Does the catapult have a safe launching mechanism? . . . . . (Yes/No)
- 7. Is the catapult safe to operate? . . . . . (Yes/No)

**EVALUATION**

Evaluation is based on the portfolio and points earned for the catapult's performance. Please refer to the official rating form for more information.

## STEM INTEGRATION

This event has connections to the STEM areas noted below. Please refer to the STEM INTEGRATION section of this guide.

Science, Technology, Engineering, Mathematics

## COMMON CORE STATE STANDARDS (CCSS) INTEGRATION

Please refer to the Common Core State Standards (CCSS) Integration section of this guide for more information.

## LEADERSHIP SKILLS

Leadership skills promoted in this event:

- Critical thinking: Students learn and use necessary skills in order to design an efficient and accurate catapult. Use leadership activities: *Guess The Famous Leader* and *Rebus Puzzles*
- Evaluation: Students improve the catapult based on testing and adjustment. Use leadership activities: *Grading the Advertisement* and *The Great "Evaluate"*
- Problem solving: Students construct a catapult that is accurate and meets all requirements. Use leadership activities: *Finding A Way* and *Resolving Conflict*

Additional leadership skills promoted in this event:

- Communication
- Team building
- Decision making
- Organization

## TSA AND CAREERS

This competition has connections to one or more of the career areas featured in the TSA AND CAREERS section of this guide. Use *The 16 Career Clusters* chart and the *TSA Competitions and Career Clusters* grid as resources for information about careers.

## CAREERS RELATED TO THIS EVENT

- Designer
- Industrial designer
- Industrial engineer
- Mechanical engineer
- Modeler

## CATAPULT DESIGN EVENT COORDINATOR INSTRUCTIONS

### PERSONNEL

- A. Event coordinator
- B. Evaluators, two (2) or more
- C. Assistants, two to three (2-3) to assist with check-in and management of the performance stage of the event (preferably one (1) per catapult being tested simultaneously).

### MATERIALS

- A. Coordinator's packet, containing:
  - 1. Event guidelines, one (1) copy for the coordinator and each evaluator
  - 2. TSA Event Coordinator Report
  - 3. List of evaluators/assistants
  - 4. Stick-on labels for identifying entries (one for the catapult and one for the design portfolio)
  - 5. Performance record sheet
  - 6. Results envelope with coordinator forms
- B. Up to four (4) golf scoring chipping targets (one per catapult on the firing line at the same time)
- C. Up to four (4) baskets or buckets large enough to hold the different colored hollow plastic practice golf balls
- D. Four (4) sets of different colored hollow plastic practice golf balls
- E. Up to four (4) bags of playground sand, each 50 pounds in weight
- F. Tape to mark the firing line
- G. Tape measures for all evaluators
- H. Bathroom weight scale
- I. Rope/stanchions or saw horses covered with plastic sheeting (in a semicircle behind the targets to control loose hollow plastic practice golf balls in the area)
- J. Tables for displaying and evaluating catapults

## RESPONSIBILITIES

- A. Upon arrival at the conference, report to the CRC room and check the contents of the coordinator's packet. Review the event guidelines and check to see that enough evaluators/assistants have been scheduled.
- B. Inspect the area(s) in which the event is to be held for appropriate set-up, including room size, chairs, tables, outlets, etc. Notify the event manager of any potential problems.
- C. Check in the entries at the time stated in the conference program. Anyone reporting who is not on the entry list may check in only after official notification is received from the CRC. Late entries are considered on a case-by-case basis and only when the lateness is caused by events beyond the participant's control. Requirements for attire do NOT apply during check-in. Secure the entries in the designated area.
- D. Each entry (catapult and design portfolio) must include the participant's identification number in the upper right-hand corner of the entry. Position entries for evaluation and viewing. Secure the entries in the designated area.
- E. One (1) hour before the event is scheduled to begin, meet with evaluators/assistants to review time limits, procedures, and regulations. If questions arise that cannot be answered, speak to the event manager before the event begins.
- F. Assist the evaluators as needed as they review the catapults and design portfolios.
- G. For participants who violate the rules, the decision either to 1) deduct twenty percent (20%) of the total possible points or 2) disqualify the entry, must be discussed and verified with the evaluators, event coordinator, and CRC manager, who all must initial either of these actions on the rating form.
- H. Begin the performance stage at the posted time.
- I. One assistant will manage the stop watch to begin ("Fire") the one (1)-minute time and to end ("Stop") the testing period.
- J. Position another assistant at each target to calculate the score for each team performing.
- K. Evaluators determine the ten (10) finalists. Evaluators should break any ties, as necessary.
- L. Submit the finalist results and all related forms in the results envelope to the CRC room.



- M. If necessary, manage security and the removal of materials from the event area.





Participant/Team ID# \_\_\_\_\_

Record scores in the column spaces below.

<b>CATAPULT DESIGN</b>		
<b>2016 &amp; 2017 OFFICIAL RATING FORM</b>		<b>MIDDLE SCHOOL</b>
<b>Catapult Design Specifications Compliance Go or No-Go</b>		
A catapult that is marked No-Go for any of the requirements below will not advance to the performance stage of the event.		
Team members must have safety goggles.	<b>Go</b>	<b>No-Go</b>
The catapult can be weighed down with a sand bag.	<b>Go</b>	<b>No-Go</b>
The catapult is the correct size.	<b>Go</b>	<b>No-Go</b>
The catapult is built with the correct materials.	<b>Go</b>	<b>No-Go</b>
The catapult launches with a pull cord.	<b>Go</b>	<b>No-Go</b>
The catapult has a safe launching mechanism.	<b>Go</b>	<b>No-Go</b>
The catapult is safe to operate.	<b>Go</b>	<b>No-Go</b>

<b>Design Portfolio (50 points)</b>			
CRITERIA	Minimal performance 1-4 points	Adequate performance 5-8 points	Exemplary performance 9-10 points
<b>Portfolio</b> (X1)	Portfolio is unorganized and/or missing three or more components.	Portfolio has most components, and it is somewhat organized.	One or no components are missing in the portfolio, and content and organization are clear.
<b>Research</b> (X1)	There is little evidence of research to help determine the design for a catapult.	Some research is present to help determine the design for a catapult.	Ample and thorough research to help determine the design for a catapult is evident.
<b>Design log</b> (X2)	Design log lacks information about the design process (including testing and adjustments) for the final catapult.	Design log adequately conveys the design process (including testing and adjustment) for the final catapult.	Design log provides thorough and quality information about the design process (including testing and adjustments) for the final catapult.
<b>Sketches and pictures</b> (X1)	Sketches and/or pictures do not help illustrate the design process.	Sketches and/or pictures are appropriate and help illustrate the design process.	Sketches and/or pictures are of excellent quality and thoroughly illustrate the design process.
<b>SUBTOTAL (50 points)</b>			
<b>Catapult Performance</b>			
	# Hollow Plastic Practice Golf Balls	Score	
Red target - 5 points each			
Green target - 2 points each			
Blue target - 1 point each			
<b>PERFORMANCE SUBTOTAL</b>			



Rules violations (a deduction of 20% of the total possible points) must be initialed by the evaluator, coordinator and manager of the event. Record the deduction in the space to the right.

Indicate the rule violated: \_\_\_\_\_

(To arrive at the TOTAL score, add any subtotals and subtract rules violation points, as necessary.)

**TOTAL SCORE**

Comments:

I certify these results to be true and accurate to the best of my knowledge.

Evaluator

Printed name: \_\_\_\_\_

Signature: \_\_\_\_\_