Engineering Around the World!

2021 Rules Packet

Scheduled for

October 20, 2021

Hosted by The University of Kansas School of Engineering
Organized by The KU SELF Program Junior Cohort

Contents

Introduction

Welcome to the official guide to KU Engineering's High School Design 2021! The competition day is October 20th, 2021. This packet will include competition rules, as well as a thorough explanation of our plans to host the competition day virtually. The safety of students, teachers, and all parties involved is our utmost priority. We have done everything possible to try to make this competition safe for all involved while still maintaining an outstanding experience for high school students to get involved and learn about engineering at KU.

Theme

The theme of this year's competition is engineering "Around the World." With the rise of a global pandemic, we have all witnessed like never before how isolation can affect the world. Our goal is to reimagine the future of connecting cultures and innovation and take competitors on an engineering adventure. Though we still may be limited in terms of travel these competitions are intended to make students think about challenges we will face as we come together as a more unified world. No matter what the future may hold we must all come together however we can to tackle the challenges it will present head on. With that in mind we here at KU can't wait to see what this year's high school design competitors will have in store for us.

Scholarship Details

For each of the six competitions, a $2,000 scholarship will be awarded to the winning team. This scholarship will be divided between all winning team members equally. Scholarships will be contingent on student(s) enrolling at the KU School of Engineering. Students will know if they received a scholarship following the competition at the award ceremony, in which the HSD team will announce all first, second, and third place winners in a Zoom meeting accessible to all participants. Only the first place team will be eligible for the scholarship in each of the six competitions. The scholarship is spread over the first two semesters at KU, 50% in the fall and 50% in the spring.

Competing in a Pandemic

States, counties, and schools each have their own regulations and requirements surrounding the coronavirus. This had created a lot of uncertainty, but that does not deter us! The High School Design Competition is an important event that inspires the next generation of engineers. We will adapt to changing circumstances and keep you updated.

However, we are limited to the conditions that the University and State of Kansas allow. If KU enforces a mask mandate, then that is what is expected of our guests. If the University of Kansas or State of Kansas cancels all events attended by guests, then we will move to a completely virtual event. Regardless of the circumstances, our High School Design team will continue to provide the testing of each project at the KU School of Engineering in order to maintain fairness and consistency throughout the testing of projects.

To accommodate this uncertainty, this year's competitions have been designed for virtual and in-person attendance. If regulations allow, our doors will be open on Oct 20 to those who feel safe

competing in person. Those who can't or don't want to attend in person can mail or drop-off their projects at The University of Kansas. Those instructions are listed in the next section. Those attending in person can bring their projects the day of the event or get them here ahead of time.

Before competition day, each team will receive a schedule with the assorted Zoom links and room locations that they will use to view the testing of their project as well as their time slot and Zoom link for their presentation component (if applicable). This schedule will also include other opportunities such as a virtual tour of the School of Engineering and a Zoom link to attend the awards ceremony.

Drop-off Instructions for Virtual Participants

All projects must be dropped off at the School of Engineering by October 18, 2021 for those not attending the competition in person. You may drop off your project as early as October 13. A more detailed drop-off schedule will be emailed to those who have registered by October 1st, and if you need more accommodations please email us at highschooldesign@ku.edu. Each project must be clearly marked with their school (if registering through school), team member's names, and team name. Please drop off at the building marked as LEEP2 (1536 W 15th St, Lawrence, KS 66045).

Mail Instructions for Virtual Participants

All projects must be delivered to the School of Engineering by 5PM on October 18, 2021 for those not attending the competition in person. Since shipping is variable, we can accommodate projects as early as October 4. To do so, use the following mailing address:

LEEP2 1536 W 15th St,
Room 1415F
Att: SELF Program
Lawrence, KS 66045.

Competition Deadlines

August 23	Registration is Open.
October 6	Final Registration Deadline
October 13	Project Drop off Begins at 8 AM
October 18	All projects must be dropped off at the KU School of Engineering by 5 PM
October 20	Competition Day

Competition Rules

The remainder of this packet will be dedicated to the actual competition rules! This year we will still be offering six different contests, each of them uniquely encouraging design thinking and creativity to solve engineering problems in six different areas of engineering or computing. Each student may compete in one contest. Students may be in teams of 1 - 4 people and each school may enter as many teams as they please in each contest, however the total number of teams per contest is limited to 40 teams per competition due to time and staffing restrictions. Please let us know what events you are planning to compete in and how many teams you will be bringing as soon as possible to secure a spot. If there are any questions about the competition rules, feel free to reach out to any of the competition leads (listed in their corresponding section of rules) or highschooldesign@ku.edu. If you don't hear back from a specific lead within 3 days, please try again and CC the highschooldesign@ku.edu mailbox and address the message to the name of the lead you are trying to contact.

Competition Leads

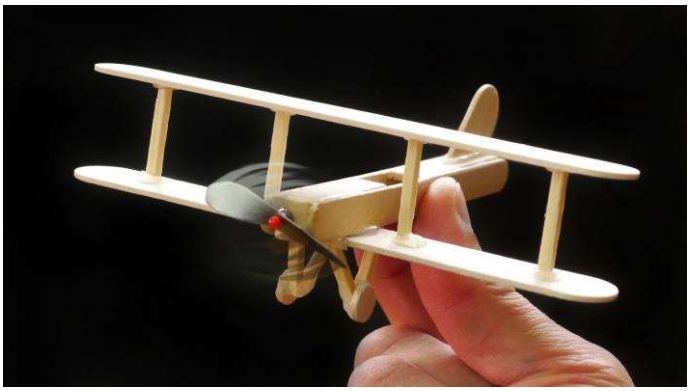
- Aerospace - Cary Smith (carysmith@ku.edu)
- Bioengineering – Charly Wang (charlywang@ku.edu)
- Chemical – Nasrin Shahlari (nasrinshahlari@ku.edu)
- Civil – Madeline Merckling at (highschooldesign@ku.edu)
- Computer Science – Will Thomas (highschooldesign@ku.edu)
- Mechanical Engineering – Bobby Lounsbury (bobbylounsbury@ku.edu).

Aerospace Competition – Aircraft Design and Fly

To clarify aerospace competition questions, please contact Carry Smith (carysmith@ku.edu).

Introduction

Engineers are looking for a vehicle design for neighbors to efficiently deliver messages to each other without the use of a mail service or electricity. They are looking for a lightweight and affordable option to make their dream come true. There are many ways of making this vehicle as aerodynamic as possible, and scientists look forward to seeing the innovation and watching them take off and complete two different tasks. These tasks will determine the winner.



All designs are allowed so long as they stay within the rules below. The following rules may seem extensive, but this was done to allow for a very open-ended competition while maintaining safety and fair play. Make sure to read the rules carefully before designing your vehicle. ***Vehicles judged to violate the rules will be disqualified.*** If there is any confusion on the rules, please don't hesitate to ask for clarification.

Competition Overview

You will construct a vehicle to complete two tasks: 1) a distance and flight time task and 2) an accuracy task. Points will be earned based on a combined score between the two tasks. In the first task, points are scored based on the most ground covered and longest time of flight. In the second, points are scored based on distance away from target. The vehicle with the most success in these tasks will be chosen by scientists as the winner.

You will be allowed up to 2 throws per task. Your best result for the task will be used as the consideration for calculating team placement within the competition.

The competition will take place in Robinson Athletic Center on the basketball courts, where distances exceed 300ft.

In addition to the vehicle, your team will provide the judges with a one-page *Design Document* that showcases your vehicle's design decisions, materials, and cost. The cost should be based on fully used or estimated cost of partially used items. (If a team used half of a glue bottle, the cost should be half of the total cost of the glue) Your team's vehicle and *Design Document* must be completed upon arrival on Wednesday, October 20th, 2021.

Competition Specification

Teams missing or disregarding any of these requirements will be disqualified:

1. All vehicles must be constructed by student team members only.
2. Have a vehicle and team name.
3. Present a *Design Document* that describes your vehicle at the time of the competition. Meeting the following requirements:
    a. It should fit on a single, one-sided piece of 8.5" x 11" paper.
    b. List your vehicle name, school at the top, and an individual to contact.
    c. Explain your design decisions.
    d. Vehicle parameters such as cost, weight, and materials used.
4. Once at the competition, team members may not alter their vehicle for each task. This means that the vehicle must hold the original form and parts throughout each competition. Damages may be fixed, but new parts and alterations to help other areas of the competition will not be allowed.
5. Only team members may throw the vehicle.
    a. Throwers must stay behind a designated line and other teams and teammates must remain out of the throwing field.
    b. The vehicle must be thrown from a stationary, standing position, with your vehicle being thrown overhand (like a baseball throw).
    c. Different team members can throw for each task.
6. Do not touch another team's aircraft.

Vehicle Specification

1. NO kits are permitted. All vehicles must be fully designed and manufactured by team members.
2. The aircraft may be any size or shape excluding disks or saucers. Aircraft may not utilize any spinning motion for stability (such as a Frisbee) or for any other function. The aircraft must demonstrate aerodynamic glider flight.
3. NO rubber bands or other power sources are permitted.
4. NO crumpled balls of paper, foil "flying" by ballistic inertia, or balls, such as footballs or baseballs are permitted.
5. Your aircraft must be under 3lbs (1,361g).
6. The total length of your aircraft must not exceed 3ft and its wingspan may not exceed 2ft.

7. No part of the aircraft may be deformed by the thrower during the throw and the aircraft may not have major changes in shape (eg. unfolding wings) during flight.
8. Your aircraft should be made from materials that will not inflict any damage on the testing site or others.
    a. Materials that may inflict damage include metal, heavy wood, flaking paint, sharp edges, and corners. All are prohibited.
9. Judges reserve the right to disqualify any vehicle that violates the rules or the spirit of the competition. Additional rules may be created and communicated to competition teams to ensure safety and fair play. Please share any concerns or questions you might have with us prior to the competition date.

Materials available on launch day:

NO MATERIALS WILL BE PROVIDED ON COMPETITION DAY! Teams will be expected to have their aircrafts ready when arriving on competition day at the University of Kansas. Each vehicle will be inspected prior to the events. Once the vehicle passes the requirements teams will hand over their aircraft until competitions begin. Teams will not be able to repair their crafts until all the teams have completed the individual event. Please bring your own materials to make any repairs. In between competitions there will be time for teams to make repairs while scoring is updated. The vehicles must be returned prior to the start of the following event.

Examples of materials that the rules prohibit:

- Drones
- Frisbees
- Purchased kits
- Batteries
- Remote controls
- Engines
- Any type of propellant
- Fans
- Any chemicals that could cause damage to the wood or finishing
- Any sticky substances that cause damage to the wood or finishing
- Launchers
- Hazardous materials such as Lead weights

Safety Throughout the Competition

1. Before competing, your vehicle will be inspected by a judge to ensure that it does not violate any of the rules.
2. All individuals must remain behind the throwing line, with exception to the official timing and measuring crew, who will be down the throwing field to accurately locate the aircraft landing spot and time.
3. Do not launch your vehicle at people or animals.

4. Never stand over a vehicle that is about to be launched.
5. The team member launching the vehicle must wear safety glasses. Safety glasses are strongly recommended for everyone present.
6. Call out a loud and clear countdown before launching your vehicle.
7. Everyone present at launch must be attentive in case a vehicle launches unpredictably.

Competition Events

See Diagrams on page 9 for a visualization of all tasks.

1. Forward Distance and Time of Flight Task
    a. Each team will have two attempts to throw their vehicle as far as possible.
    b. The throw must be made from a standing position.
    c. The thrower must throw in a baseball toss maneuver (no frisbee or cross body style).
    d. The thrower must be standing on the ground, and not elevated (on a chair, or ladder, etc.).
    e. The thrower must remain behind a designated line until the aircraft has landed.
    f. The measurement will be where the vehicle first makes contact with the ground, not the final stopping location.
    g. All other team members must remain behind the thrower in their designated areas.
    h. The distance measured will not account for any displacement to the left or the right of the thrower.
        i. From the throwing line, a straight perpendicular path will be used to measure the distance that the vehicle flew.
        ii. The thrower crossing the line at any point during the toss will result in a disqualified throw.
        iii. Any team member leaving the designated area before the aircraft has landed will result in a disqualified throw.
        iv. If an aircraft is to return to the thrower (in a boomerang style), the throw will be disqualified.
    i. The time will be taken from the moment that the vehicle is thrown until the vehicle comes into contact with the ground.
    j. All vehicles must land on the gym floor and not make contact with any other object before landing.
    k. There will be 2 official judges taking time. We will average their times to find a score for each team. We will also have a video of launches to retime if there are discrepancies in the time to ensure accurate scoring. The team that has the attempt with the longest flight time will win the event.
2. Accuracy Task
    a. Each team will have two attempts to throw their aircraft so that it is as close to a target as possible.
    b. The throw must be made from a standing position.

c. The thrower must throw in a baseball toss maneuver (no frisbee or cross body style).
d. The thrower must be standing on the ground, and not elevated (on a chair, or ladder, etc.).
e. The thrower must remain behind a designated line until the aircraft has landed.
f. All other team members must remain behind the thrower in their designated areas.
g. A map will be placed 100 feet away from the designated line in the gymnasium, laying flat on the ground. The task will be for teams to attempt to land their aircraft as close as possible to the target: Lawrence, Kansas.
h. Measurements will be taken from the point of the vehicle that is closest to the location to the location in the most direct linear path once the vehicle has stopped moving.
i. The team that has the attempt that is closest to the location will win the event.
    i. The thrower crossing the line at any point during the toss will result in a disqualified throw.
    ii. Any team member leaving the designated area before the aircraft has landed will result in a disqualified throw.
    iii. If an aircraft is to return to the thrower (in a boomerang style), the throw will be disqualified.

Launch Sequence

After sign-up has concluded, each team will be randomly assigned a team number. There will be one number for each team that will be participating (example: if ten teams register, the teams will be numbered 1-10.). These team numbers will be used for ordering the tossing. For each category of the competition, the numbers will be randomized to create an order in which the teams will throw. (example: ten teams register and are picked at random. The order for the distance competition may be 6,3,9,2,1,4,10,7,8.) And then randomly selected again for the other competitions. Teams will be given their position on the day of the competition.

When it is the team's turn to compete in the competition, only members of that team may be on the launch grounds. All other teams must be in the stands. The team will designate a thrower to perform the task. The thrower must remain behind the launch line until the plane has landed. All other team members must remain in the designated section until then as well. The plane will be measured and returned to the thrower. At this point the thrower may repeat the process for a total of two tosses. The thrower does not have to remain the same throughout the competition. The only criteria is that the thrower must be a part of the team, must throw from a standing position on the court, and remain behind the line.

Once a team has completed their tosses for the specific competition, they will return the stands without their aircraft and the next team will perform their tasks. Once all teams have completed the event, scoring will be determined and current rankings will be posted. During this scoring, teams may take their craft and perform basic repairs. A 15 minute time will be designated for repairs. Vehicles must be returned after this time. Then, the next event will begin.

Penalties

Our goal is to create a fun, safe, and equal environment for all who are participating in High School Design. All of these rules will be enforced throughout the competition.

1. Any vehicle that does not meet the requirements listed in these rules will not be permitted to compete.
2. Crossing the line while throwing will disqualify your attempt.
3. When you receive your aircraft to throw, you will have 60 seconds to begin your throw. If the aircraft has not taken off after these 60 seconds, your throw will be disqualified.
4. Tampering with other team's aircraft will result in immediate disqualification from the competition.
5. Altering your own aircraft to improve flight will result in disqualification.
    a. Team members may not add or remove new parts to improve flight for different tasks.
    b. Simple repairs may be performed if damage occurs during the competition, and may only be completed during the 15 minute designated time.
3. Intentionally distracting a team while they are competing will result in immediate disqualification from the competition.
4. Use of inappropriate language or interaction towards another team will first be issued a warning and then disqualified from the competition.

Determining the Winner

1. In each event teams will be ranked based on their performance compared to other teams.
    a. A team will be awarded a point value based on their placement in respect to the other teams. (1st place is 1 point and 10th place is 10 points)
        i. Scoring in the Forward Distance and Time of Flight Task will be as such: The distance in feet will be added to the time of flight in seconds to provide a score to each team. The team with the highest score in this task will get 1st place and so on.
    b. At the end of each event scores and rankings will be available for all to view. Once these scores are updated, they are final.
    c. At the conclusion of the competition, the team with the fewest points will be declared the winner.

Sample Grading Rank	Team 1	Team 2	Team 3	Team 4	Team 5

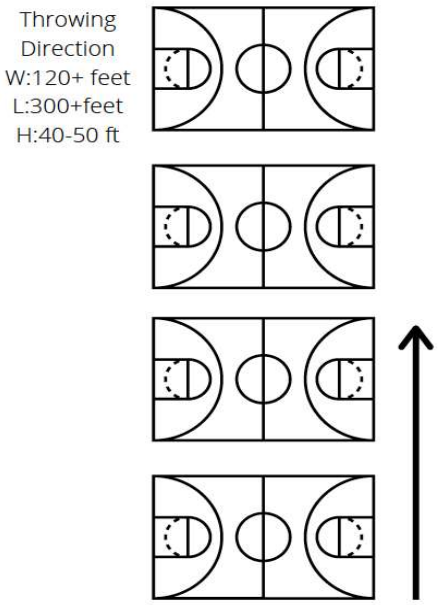
Forward Distance and Time of Flight (m+s)	2	4	1	3	5
Accuracy Task (m)	4	3	2	1	5
Total Points	9	8	7	6	15

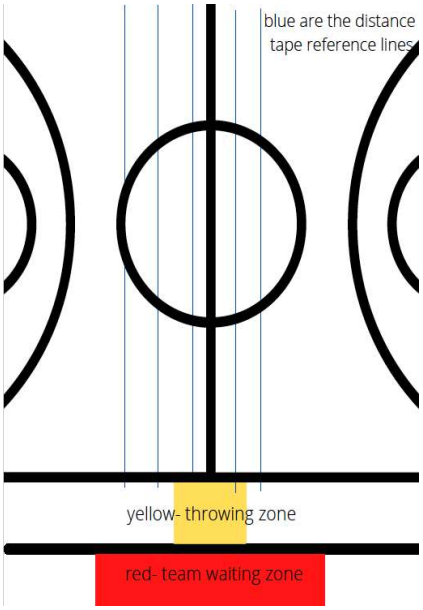
d. The sample grading rank shows that Team 4, with 6 final points, would be the winner because they ranked the best across both tasks. Similarly, Team 5 would be 5th overall because they ranked the lowest in the tasks.

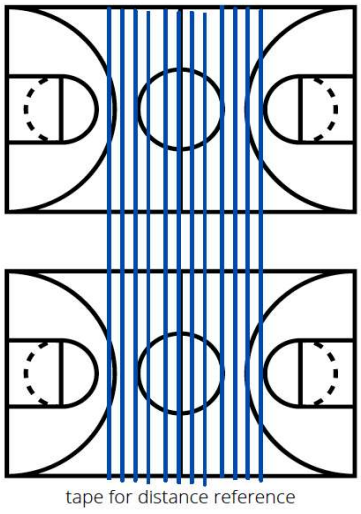
2. Tie breaker
   a. In the case that two or more teams have the same score at the end of the competition teams will be judged on price of their competitions. Each team is required to show the cost of production in their *Design Document*. Judges will examine each document and the team with the lower cost will win.

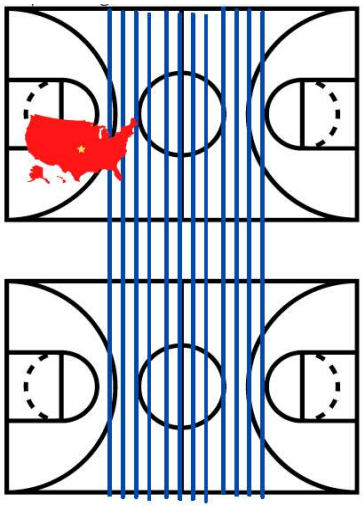
Diagrams of the Event Space

There will be lines of tape on the ground, shown by blue lines in the diagrams. These tape lines are to help measure the Forward Distance and Time of Flight Task, and marks will be made on the tape every few feet to make measuring easy. The map used for the Accuracy Task will be placed after the Forward Distance and Time of Flight Task has been completed. The picture on the next page is simply an example of where a map could be placed, but the exact location will not be known until teams arrive.






tape for distance reference



Bioengineering Competition – Artificial Heart Valve Surgery

To clarify bioengineering competition questions, please contact Charly Wang (charlywang@ku.edu).

Introduction

The leading killer in the world is cardiovascular disease (CVD). Almost 80% of all cardiovascular diseases are happening in developing countries[1]. The diseases occurring in developing countries are treated differently compared to western medicine and need to have a solution that is cost effective and accessible to all countries. **The challenge is to create a cost effective, artificial aortic heart valve that will perform based on pressure in the heart. It should be made of readily available materials that are easily manufactured around the world. In addition, create a presentation with this universal design solution.**

Specifications:[2]

The valve must…

- Be able to have 2 functions – open and closed valve
    - Open valve: can pass blood through
        - The inner circumference of the 1" PVC piping must be completely uncovered
    - Closed valve: cannot pass blood through
        - The inner circumference of the 1" PVC piping must be completely covered
- All projects must have a 1" PVC threaded male connector attached on their device to be able to connect to the testing portion on competition day
- Have the starting position be closed valve
- Open and close on its own based on the pressure (without assistance of someone, but if this cannot be achieved, point deductions will occur – specified in the rubric below)
    - Examples that will have point deductions: team member closes valve themselves, valve is controlled by a circuit, time, or anything else other than pressure
- Be made from materials that can withstand water for testing
- Be sized appropriately to fit within 12" x 12" x 12" in volume
- Cost effective, under $49, full points awarded to teams that spend under this amount. Deduction of points will be made in increments according to the rubric below.
- Be made from materials that are easily and universally accessible. Specific materials like 3D printed and laser cut materials will have a deduction of points as specified in rubric
- Clarification: the valve can be partially opened before 45-50 psi to reach maximum points. The final pressure reading will be when the valve is fully opened
- Fully open within the water pressure range of 45-50 psi
- Have the water drain out from the project (the water will flow into a bucket or sink)

Competition phases:

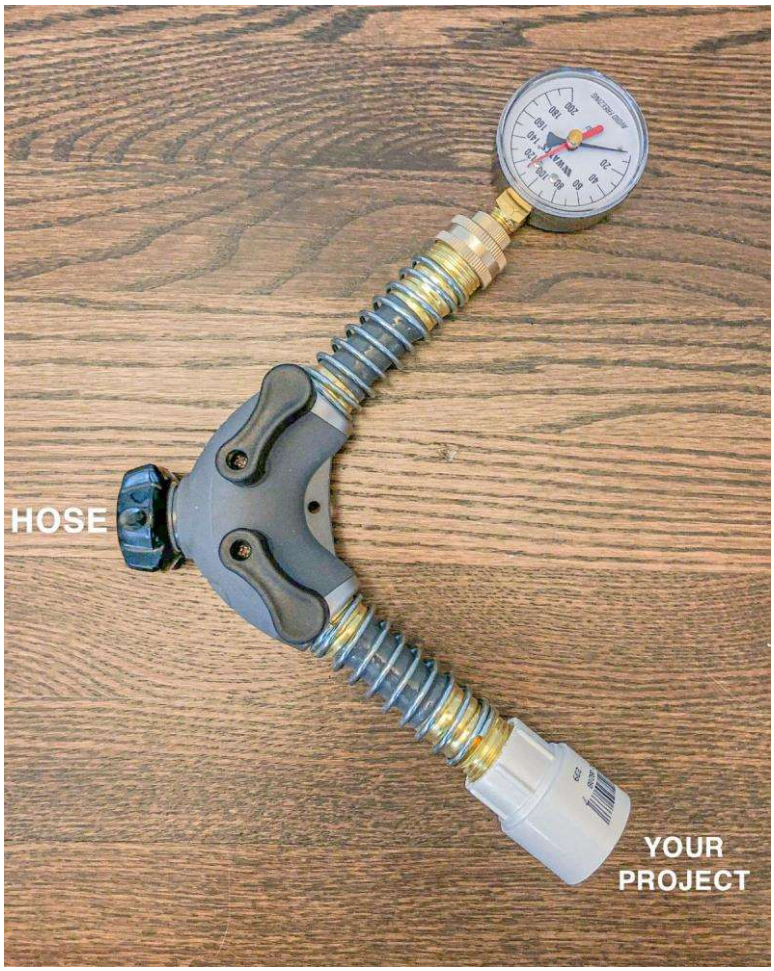
Presentation Phase

Teams will present their design in detail and clarity. The presentation should include the supply chain of materials and the cost breakdown of each component. Please provide receipts or an itemized list of supplies if possible. The presentation should be within 5-10 minutes and demonstrate that everyone on the team contributes to the presentation of the prototype (i.e. calculations, iteration stages, etc). In the prompt, we are asking that projects are made from materials that are accessible *around the world*. Teams should explain how universal their materials are. Team members should expect to answer questions to the fullest at the end of their presentation.

Demonstration Phase

Teams will demonstrate their project by connecting their 1" threaded male PVC piping to the connector which will be attached to the hose. The valve must start in the closed position. The hose will be turned on starting from lowest pressure (0 psi) and gradually increasing all the way to 50 psi. Prototype valves are expected to fully open in the 45 psi – 50 psi range. The max pressure the valve is completely open at will be recorded. The best score out of the two tests will be taken. Only two chances will be given. In case of any false starts or mistakes, this will be used as one of the attempts.

Below is a diagram of how testing day will look like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PROJECT

	Point Value					Bonus
Presentation Phase						
Time	5 Presented in the 5-10 minute range	4 Within 30 seconds of time range	3 Within 1 minute of time range	2 Within 1 minute 30 seconds of time range	1 More than 1 minute 30 seconds out of time range	
Content	10 Clear and thorough overview of prototype, explain supply chain and cost of materials used (receipts)	8 Strong overview of prototype but supply chain and cost of materials are not detailed	6 Overview of prototype but lacks detail of supply chain and cost of materials	4 Poor overview of prototype and lacks detail of supply chain and cost of materials	2 Little to no overview of prototype, supply chain, or cost of materials	
Design	10 Clear and thorough detail the features of the design, highlight major aspects of production	8 Detail the structural features and aspects of production, but does not highlight all vital aspects	6 Includes most major details of structure and production, but multiple questions persist	4 Provides some details of the structural components and production, but does not highlight the features	2 Provides little to no detail concerning structural components and the production methods	
Context	15 Connects to the theme of around the world and directs the presentation shows that all materials are accessible around the world		10 Somewhat connects to the theme. Shows that at least half of the materials are accessible around the world		5 Provides little to no connection to the theme. Shows at least one of the materials is accessible around the world	
Presentation	10 Presentation demonstrated a creative and clear platform with a high level of business acumen	8 Presentation demonstrated professionalism and business acumen but does not captivate audience	6 Presentation was professional but lacked high levels of business acumen	4 Presentation showed lack of high levels of professionalism and business acumen	2 Presentation showed some professionalism but not very convincing and lacked business acumen	
Questions	10 Team can answer and elaborate on all questions from the Board of Directors in their entirety and to the satisfaction.	8 Team answers all questions to Board's satisfaction, but does not elaborate	6 Team answers most questions to Board's satisfaction but leave only a few questions remaining.	4 Team answers some questions in their entirety but do not satisfy Board with most of their questions	2 Team answers little to no questions, leaving Board with many unfulfilled questions	
Demonstration Phase						
Cost	25 $0-$49	20 $50-$59	15 $60-$69	10 $70-$79	5 $80+	
Functionality	20 Valve opened completely within the water pressure range of 45-50 psi	16 Valve opened completely within the water pressure range of 40-44 psi	12 Valve opened completely within the water pressure range of 35-39 psi	8 Valve opened completely within the water pressure range of 30-34 psi	4 Valve opened completely below the water pressure 29 psi	
Accessibility	10 Prototype uses all accessible materials and no specific parts like 3D printed or laser cut	8 Prototype uses all accessible materials but has one 3D printed or laser cut, specific part	6 Prototype uses all accessible materials but has two 3D printed or laser cut, specific part	4 Prototype uses all accessible materials but has three 3D printed or laser cut, specific part	2 Prototype uses all accessible materials but has four or more 3D printed or laser cut, specific part	
Autonomy	25 Prototype can perform fully on its own	20 Prototype can perform on its own and has few issues that need hands on iteration	15 Prototype is designed to perform on its own but needs a lot of hands-on help	10 Prototype is controlled by someone for each valve movement	5 Prototype is controlled purely by someone else	
Size	10 Fits in 12"x12"x12"		6 Fits in size constraint but has little to some components sticking out		2 Most does not fit in size constraint but does still cover the piping	
Total Points		Comments:				

Chemical Competition – Purifying Kansas River Water

To clarify chemical competition questions, please contact Nasrin Shahlari (nasrinshahlari@ku.edu)

Introduction

Your team has been recruited by the University of Kansas to filter the water in the Kansas River. The Kansas River is heavily polluted due to waste that is thrown into the river, runoff from farmlands and city streets, pesticides, fertilizers (nitrogen), animal waste, and more. The University of Kansas needs your team to design a filtration system to improve the Kansas River water to drinking water standards.

Competition Specifications

Filter system

- The filtration system should filter components such as Styrofoam, mud, sand, plastic bags, microplastic, metal, and oil.
- The maximum concentration of oil in the Kansas River is found to be 0.5%, the maximum plastic in the river is 10%, and the maximum mud in the river is 20%.
- No reactive or hazardous materials (halogens, natural gas, strong acids/bases; must be safe to consume after the filtration process) may be used. *Please include a Safety Data Sheet for all the chemicals used for the filter.*
- Any filter that uses a kit will be disqualified. Kits are filters that are pre-designed and only take assembly. All filters should be designed from scratch.

Filter Specifications

- The filtered water must be treated to test at a pH between 6.8 - 8.2, transparent, and the filtered water must be delivered to a transportable container. (pH strips will be provided.)
- The filter must contain a transport (from filter to clean water) to a cup or tub of water by using a piping system.
- The filter must be able to handle 1 liter of Kansas River water passing through it.

Presentation of Reaction

The first part will be presenting the filter and elaborating on how it was made.

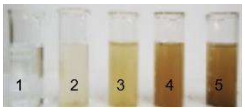
The second part will be a presentation given live or during a live Zoom call. The presentation should detail but is not limited to, how the filter works, why it works, the reason for why each part was chosen, and how it relates to the High School Design theme of Around the World. This part of the competition is worth 25 points. Presentations should be between 5-10 minutes.

The third part of the presentation will be running the Kansas River Water through the filter.

Components in the Kansas River Water: CO_2, Oil, Iron, Mud, silt, soil, Plastic bags, “e. Coli,” Styrofoam.

Category	Developing	Competent	Exemplary	Points
Presentation ___/25				
Group Participation	Limited group members speaking (1)	Few group members present. (2)	All group members participate in the presentation. (3)	**__/3**
Confidence in Material	Gaps in understanding and little to no confidence with the material (1)	Basic understanding and some confidence in material (5)	Expert understanding and confident in the material (10)	**___/10**
Eye Contact	No eye contact (0)	Little to no eye contact (½)	Frequent eye contact (1)	**__/1**
Connection to Theme	Does not connect presentation to the main theme of around the world. (1)	Basic connection of project to the theme of around the world. (2)	Detailed connection of project to the theme of around the world. (3)	**__/3**
Organization	Not organized. (0)	Needs more organization to help flow (1)	Well organized (2)	**__/2**
Overall Presentation (any source is acceptable)	Formatting in the presentation is not efficient in displaying the material. (0.4) Visual is not engaging (0.3) Hard to follow. (0.3)	Formatting is not efficient in displaying material. (1) Visual not thoroughly engaging. (1) Slightly difficult to follow. (1)	Formatting is efficient in displaying material. (2) Visually engaging (2) Easy to follow. (2)	**__/6**
Filter Efficiency ____/30				
Functioning Filter	Non-functioning (3)	Filter functions sometimes (5)	Functioning Filter and all components are filtered (10)	**__/10**
Turbidity*	Little to nothing filtered from the Kansas River Water (High Turbidity) (3)	Filters some pollutants but not all (medium turbidity) (5)	Functioning Filter and all components are filtered (7)	**__/7**
Piping System	Piping system connecting funnel to water cup or tub not included (0)	Piping system connecting funnel to water cup or tub leaks (2)	Kansas River water is completely filtered (low turbidity) (10)	**__/3**
pH	pH of filtered water is super acidic or super basic. (1)	pH is slightly too acidic or too basic for drinking water (2)	Piping system connecting funnel to water cup or tub works efficiently (3) *pH of filtered water is 6.8-8.2 (4)	**__/4**
Filter Time	Takes > 5 minutes to filter 1 L (1)	Takes 2-5 minutes to filter 1 L (3)	Takes < 2 minutes to filter 1 L (6)	**__/6**
Research ____/25				
Design Concepts	Not able to explain concepts behind the project (0)	Basic explanation of some concepts/ideas behind the project. (5)	Thorough documentation of design and brainstorming (10) *A) Group can explain the research and idea behind the parts of their filter. (8/10) B) Examples from industry where applicable process (2/10)*	**__/10**
Diagram	No documentation of design or diagram (0)	Some documentation of design and a limited diagram (3)	Diagrams of design/build process (5)	**__/5**
Citations	No citations. Little to no research done on outside sources. (0)	Some citations included with outside sources (½)	Through citations included (1)	**__/1**
Group Work	One member of the group did all the research. (0)	Some delegation between team members on research (1)	Explanation or work and leadership system delegation (3)	**__/3**
Q/A	Not able to answer questions asked during Q & A session after presentation (0)	Able to answer some questions asked during Q & A session after presentation. (2)	Able to answer all questions asked during Q & A session after presentation (4)	**__/4**
Safety Data Sheet	No safety data sheet for chemicals included. (0)	Safety data sheet for some chemicals (1)	Safety data sheet for all chemicals (2)	**__/2**
Creativity ____/10				
Originality	Idea is not original (1)	Ideas from industry (5)	Original ideas but supplemented with research from industry. (10)	**__/10**
Cost Awareness ____/10				
Cost	More than $50 (1)	$15-$50 (5)	Less than $15 (10)	**__/10**

*Turbidity graded on a scale of water darkness scale below (1 to 5 points)



Competition Deliverables

1. ***Your Filter system.*** This should be labeled with a team name and contact information.
2. ***Presentation materials.*** PowerPoint, poster, etc.
3. ***Bill of Materials.*** Emailed spreadsheet containing materials used and cost of each.
4. ***Email with photos of materials.*** Send an email to nasrinshahlari@ku.edu with photocopies for *every* item that went into the construction of the filter by October 18.

Example of Bill of Materials Excel Sheet Header:

Description of Part / Expense	Where was it Purchased (if not found around the house)	Cost of Item (do not type $)	Total Expenses:	$-

Civil Engineering Competition – Sustainable Building

To clarify civil competition questions, please contact Madeline Merckling (mjmerckling@ku.edu).

Introduction

The year is 2050. Climate change is intensifying and with it the number of natural disasters and severe weather-related catastrophes are increasing. You are a professional Civil Engineer and it is your job to help design a building that is sustainable and works to reverse the effects of climate change. The construction industry accounts for approximately 50% of all air pollutants globally--the role that you play in this project is crucial and the impact you have in reversing the climate crisis is immense. Your task is to design a public community building of your choosing (think library, fire station, school, museum, etc.) in any location around the world with an emphasis on eco-friendly design.

Your structure must follow the specifications listed below in order to compete in the competition. Additionally, there will be four aspects and a bonus opportunity contributing to the overall grading of your project: 1) Load/Mass Ratio Testing, 2) Presentation, 3) Eco-friendly Design, and 4) Aesthetics.

Specifications

- MUST use ¼" width and thickness balsa wood for entire structure
- MUST have a flat top
- No more than 4 students per team
- Total height range: min 1'- max 3'
- Total width range: min 1'- max 2'
- Minimum 2 stories (one story is defined by a floor separation)
- No more than 4 balsa wood pieces may be taped or glued together in terms of thickness (this does NOT apply to vertical stacking of balsa wood ie. making the building taller—the only limit for height is 4 feet total)
- Building must be free-standing (no external supports and base can't be a solid platform)
- Building and presentation must be completed prior to arrival at KU

Must follow all specifications in order to avoid disqualification!

Load/Mass Ratio Testing

- Your building will be tested by applying a distributed weight to the TOP of your structure in 5lb increments until your building fails completely (total destruction). This information will tell us how well-suited your building is to withstand changes caused by severe weather such as hurricanes, tornados, and earthquakes.

- Load/Mass ratio is based on load withstood before your building falls or breaks completely divided by the total mass of your building.
- Percentile range scoring is based off of ranking the teams by which load/mass ratios are the highest at the end of the competition. For example the strongest 20% will earn 30 points, the next 20% will earn 24 points, etc.
- The load the structure breaks at will not be the load recorded for the load/mass ratio, instead it will be the load prior to total demolition.

Load/Mass Ratio Percentile Range	Points Awarded
0-20%	6
20-40%	12
40-60%	18
60-80%	24
80-100%	30

Total Testing Points Available: 30

Presentation

- Your group will create a short (maximum 5 minutes) presentation highlighting the choices made that contribute to the overall durability/strength of your building, eco-friendly design elements, and location choice
- Include an explanation of the geographic location chosen and how the aesthetics of your building match the architecture + physical characteristics and needs of this location

	Beginner 1 point	Developing 2 points	Acceptable 3 points	Effective 4 points	Excellent 5 points
Design Explanation (includes structural, eco-friendly, and	Failed to address prompt or only explained one part of prompt	Slightly addressed prompts but not fully, addressed more than 1 prompt	Addressed some portion of all 3 prompts with vague explanations	Addressed all 3 prompts effectively and with some level of detail	Full detail and explanation behind design choices, well thought out and fully addressed each prompt

location prompts)					
Presentation Skills	No eye contact, no team introduction, too quiet to hear	Minimal eye contact, barely/no team intro, barely audible	Some eye contact, good intro, good voice projection	Good eye contact and intro, good voice projection, even distribution of speaking parts	Captivating presentation, great eye contact and voice volume, members present equally
Knowledge and Enthusiasm	No explanation of design process, knowledge about building, or enthusiasm	Vague description of design process, little knowledge about building, not much enthusiasm	Some explanation of design process, some knowledge about building, some enthusiasm	Good explanation and knowledge about building, mostly enthusiastic	Fully explains the design process, knowledgeable and enthusiastic about building

Total Presentation Points Available: 15

Eco-friendly Design

- It is acceptable for the eco-friendly aspect of the project to be seen in your presentation rather than physically on the building
- Ideas: Add a hypothetical building material to your presentation and explain why it is a sustainable choice, energy consumption, minimal impact

	Beginner 1 point	**Developing 2 points**	**Acceptable 3 points**	**Effective 4 points**	**Excellent 5 points**
Sustainability Incorporation	Minimal incorporation of eco-friendly design	Some incorporation of eco-friendly design was displayed	Eco-friendly aspect of project was made clear and was significant to design	Eco-friendly aspect was displayed clearly and provided a creative and effective solution	LEED worthy building where eco aspects were excellently incorporated and

					thoroughly researched
Research Behind	No research or explanation of eco-friendly aspect	Minimal research and slight explanation of eco-friendly aspect	Some research and decent explanation of eco-friendly aspect	Research was completed and knowledge behind design was displayed	Detailed research went into design and knowledge on topic was extensive

Total Eco-Friendly Design Points Available: 10

Aesthetics

- Based on how neat/clean the project appears and how well the team incorporates their chosen geographic location into the final product

	Beginner 1 point	**Developing 2 points**	**Acceptable 3 points**	**Effective 4 points**	**Excellent 5 points**
Location Incorporation	No signs of geographic location seen in final design image	Minimal effort towards incorporating geographic location in aesthetic choices	Some effort put in towards connecting location with design elements; image is distinguishable	Good effort put in to distinguishing the building to match location	Design and location are well incorporated and easily understood
Overall Look/ Neatness of Product	Final product is messy and incomplete, lacks creativity	Final product is finished but lacks creativity and neatness	Final product is neat and effort was put in to making building look presentable	Final product shows creativity and care taken to make it neat	Final product is very creative and appealing, the design is clean

Total Aesthetic Points Available: 10

Bonus

- Recycled material element: add recycled materials to your building space (tissue box, cardboard, water bottles)
- The element should be non-structural (i.e. doesn't add support or strength to the structure)
- They must be attached to your building in some way (i.e. glue or tape)
    - No glass or objects that might be sharp if broken
    - These materials could represent things like book shelves, tables, seating, etc.

	Beginner **1 point**	**Acceptable** **2 points**	**Excellent** **3 points**
Creativity/ Incorporation	The building includes a recycled material element, but lacks creativity or effort	The building includes a recycled material element and the element is moderately creative	The building includes a recycled material element; the element is both creative and practical for the space
Attached to Building	Element is not very well attached to building/is falling off of the building	Element is secured to building	Element is very secure and is attached cleanly onto the building

Total Bonus Points Available: 6

Final Grade Breakdown: Your Score /65

*65 does not include the 6 bonus points

- In the case of a tie in overall scores, the higher score in Load/Mass testing will win. If teams have the same score in Load/Mass testing the next tie breaker will be Presentation, then Eco-Friendly Design, Aesthetics, and lastly Bonus. In the case of a tie in every area, the judges will choose a winner at their discretion.
- Questions or concerns? Feel free to contact Madeline Merckling, mjmerckling@ku.edu

Computer Science Competition – Capture the Flag

To clarify computer science competition questions, please contact Will Thomas (highschooldesign@ku.edu).

Introduction

Each student team, consisting of 1-4 students, will be presented with a site with Capture the Flag style questions. With these types of questions, each site you visit will present you with a problem, and then the solution to the problem will be a key/flag that the team will capture. Capturing the most flags in the fastest time is the overall way to win the game. The primary focus of the problems will be to test the principles of programming, cryptography, cyber-security, and computer science concepts. The best way to prepare for the competition is finding practice questions to work on. CodeAcademy, Euler Project, and Leetcode are three resources for preparing for the competition. Also see the sub-section "Problem Topics" for an outline of the types of problems to expect in the competition.

Competition Rules

Main Methodology

- Each team will be solving the questions in any way that they can (provided it does not violate the rules specified below).
- Use of computers is allowed.
- Teams should expect to use many different methodologies to solve problems based upon the given problem type. Some will require coding, other will require calculations, some may simply require thinking or investigative searching.

Timing

- Teams will be allotted a block of **2 hours** to complete as many of the available problems as they can.
- Teams are not expected to finish every problem and should optimally play upon their strengths to quickly solve the problems that they are able to first.
- During the competition, each team should be using one computer to complete the online assessment.
- On the day of the event, teams will receive an email with a link to a Zoom call to check-in with the Computer Science team. Students **must** stay in the call during the 2 hours with webcams on.
- Teams should expect to be given access to a website on which the CTF questions will be presented on the day of the competition.
- In the call, the High School Design team will check to make sure everyone has access to the Capture the Flag website for 30 minutes before starting.
- If a school does have an issue during the competition, the school will join a breakout call with staff to fix any issues / answer questions they may have.

Problem Structure

- Each team will be given access to the website on which the Capture the Flag style problems will be hosted.

- The specific questions will vary in difficulty and teams will be allowed to complete the questions in any order that they choose.
- All problems will be described uniformly. Each question will have an introduction to the problem and will set up the scenario and describe what challenges the program will solve.
- Problems will tell you exactly what to submit as your key value to get the solution.
- The solution key will then be put into the URL in a unique format to specify by the problem itself.
- Teams must then record the solution keys that they must gain points.
- Upon finding a solution, the team should send a message to the SELF proctoring to ensure that the time the solved the problem has been recorded so that they may win in the case of a tie breaker.

EXAMPLE:

Given a submission URL format like https://thesite.com/{School_Name}/ the correctly formatted URL (using the University of Kansas as the school) would be: https://thesite.com/University_of_Kansas/. You would then follow this URL to the correct website and it would have the points for you.

Scoring and Tie Breakers

- Each problem will be assigned its own score.
- The harder the problem is to solve, the more points it will be out of. For example, an extremely difficult problem would be worth 25 points, while a simple problem may be worth only 1 point.
- Teams may optionally show their work to complete a problem, in which case some partial points may be given to the team.
- Whichever team accumulates the most points will be declared the winner. In the event of a tie, the team that accumulated the most points the fastest will be declared the winner.

Cheating

Teams are only allowed to access any tools in general that they see fit to help them solve the given problems with **ONE LIMITATION!** No tools may be used that will try to:

1. Exploit the KU Web Server
2. Create absurd amount of traffic to the KU Web Server (Brute force URL searching)
3. Gain illegitimate access to underlying KU Web Server files

Any team that is found to have done something like this will not only be disqualified but depending on the severity of the infraction may face **criminal charges.** DON'T DO IT!

Illegitimate and/or early access to the competition website will be monitored for and will result in immediate disqualification.

You may certainly use any program you write yourself and/or programs you find online to help you solve the problems just so long as they are completely legal and will not be exploiting the KU Web Services in any way!

Additionally, no direct contact between teams, or anyone outside of the specific students engaged in the competition, will be allowed. Anyone found sharing answers (or even methods to get answers) will be immediately disqualified.

Problem Topics

Each team should be familiar with basic programming, cryptography, cyber-security, and computer science concepts. Possible problem topics include:

- Programming:
  - Algorithm creation
  - Code Optimization
- Cryptography:
  - Hashing
  - Cyphers
  - Etc.
- Cyber-Security:
  - Web-based vulnerabilities
- Computer Science:
  - Set Theory
  - Regular Expressions

Rule Changes

All rules are subject to change. If a rule change occurs, all teams will be notified via email.

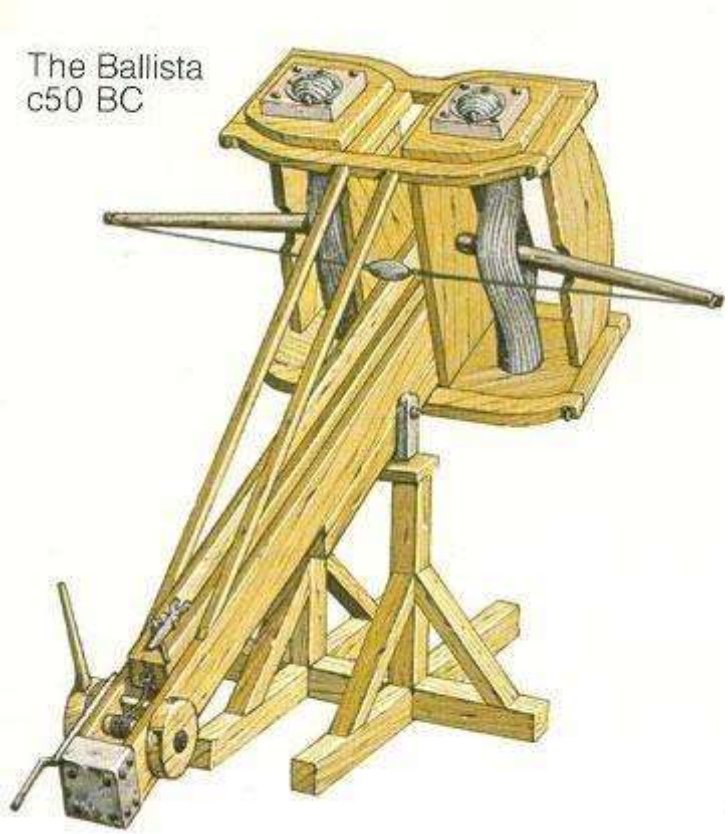
Mechanical Engineering Competition – Catapult

To clarify ME competition questions, please contact Bobby Lounsbury (bobbylounsbury@ku.edu).

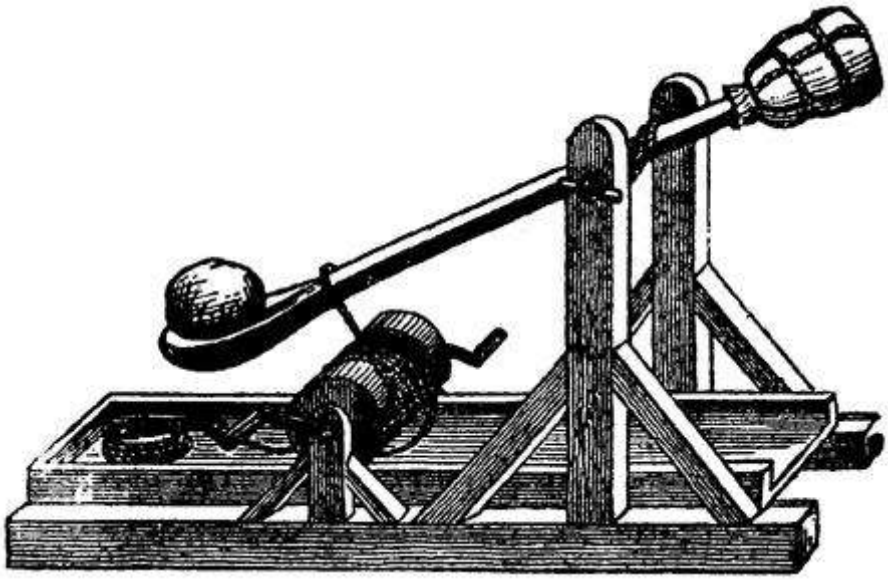
Introduction

As early as 400 BCE, catapults were used as weapons of war. Mainly utilized as siege weapons or artillery, catapults were used against castle walls and on battlefields. Catapults were used in many ancient civilizations all over the world. These civilizations included Greece, India, Rome, France, and China. Three main designs quickly emerged: ballista, mangonel, and trebuchet. These designs are all pictured below. In this competition it is encouraged to look at the catapult designs and find ways to incorporate these designs into your project. In the case of a tie, the team who best incorporated the designs of the catapults will be awarded victory.

Ballista (essentially a giant crossbow) - Used in Greece and Rome



Mangonel (traditional catapult) - Used in Rome and India



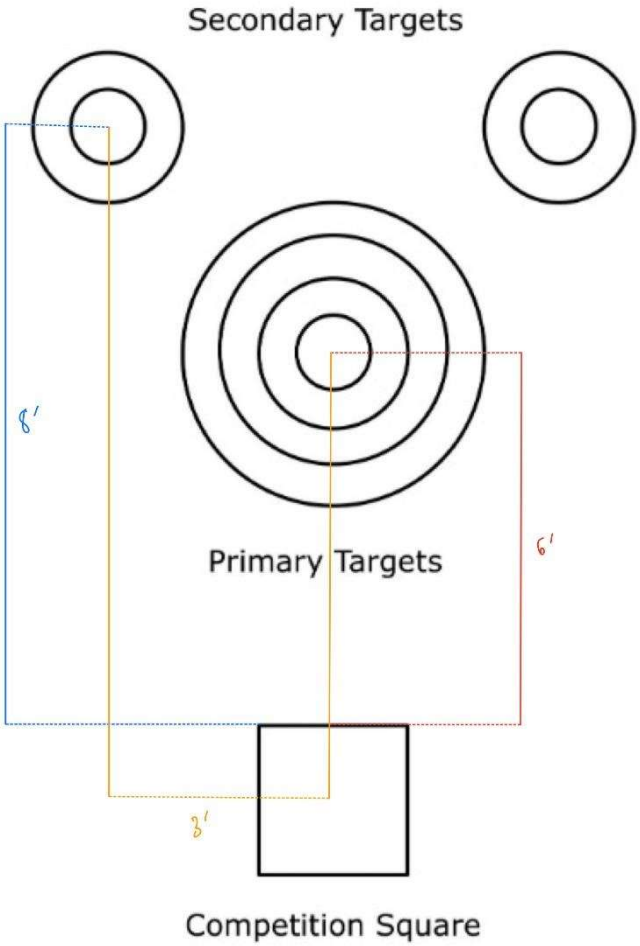
Trebuchet (weighted catapult) - Used in China and France

The Competition

Your objective is to build a catapult to accurately launch a small ball (you may use any kind of ball if the diameter is under 2 inches) onto targets using a source of potential energy. You will also be creating a presentation, graded based on the rubric at the bottom of the sheet. In your 3-minute presentation, be sure to explain your design process, any struggles, what you did to overcome them, and what you would change if you were to go through this competition again.

The "Battlefield"

Each Bullseye is 12 inches in diameter, while every subsequent ring is 6 inches thick.



Construction Materials & Manufacturing

Teams are allowed to use any materials or manufacturing methods as long as there is a budget of $40 to purchase additional materials. A detailed list of all materials acquired must be provided, along with purchase receipts. Teams may not use premade kits or, if printing parts, premade designs from sites such as Thingiverse. The catapult design should be the work of your team.

Construction Parameters

- No chemical or electrical potential energy is allowed

- The device in its starting configuration must fit inside a 18" x 18" x 18" box.
- The maximum allowed budget for other materials used in the final project is $40.
- The maximum number of team members is 5.
- The maximum allowed weight of the device is 5 lb.

Competition Day Rules

A.1 - Safety

- Safety glasses must be always worn while in the competition room. Teams must bring their own; glasses will not be provided.
- All team members must stay behind the marked safety line during their allotted time.

A.2 - Procedures

- While 5 members are allowed on a team, only two are allowed in the competition box at a time. Between each attempt, teams may rotate out which students are in the competition box.
- 3 attempts will be scored within a single 10-minute window, with 2 "failed" attempts allowed.
    - A "failed" attempt is when the ball does not cross the front of the competition square, or a break occurs on the device.
- The catapult must remain inside the competition square in its ready-to-fire position, but can expand outside of it after firing, for example a catapult arm swinging and landing on the ground in front of the square, that is okay, the arm just needs to be back inside the square before the next firing.
- Repairs will be allowed during the 10 minutes, but there will be no access to power outlets. All repairs will occur within the competition box.
- While launching, the device must stand on its own. The only part allowed to be touched is the launching arm.

Scoring - Summation of Catapult and Presentation Scores

- **Catapult Score (3x)**
- Final scores will be the sum of the points from all three attempts.
- Scores are measured from initial impact and not final position (balls will land in sand to limit movement)
    - Main Target
        - 10 points – Innermost Circle
        - 8 points – 1st Ring
        - 6 points – 2nd Ring
        - 4 points – Outer Ring
    - Secondary Targets

    - 15 points – Innermost Circle
    - 13 points – Outer Ring
- **Presentation Score**
    - Score out of 80 -from below rubric- is divided by 80 and multiplied by 15.
    - Total weighted presentation score will be out of 15 available points.
- **Total score**
    - Out of 60 points.
    - In case of tie, winning design will be selected on decorative relevancy to "Around the World" theme (project is decorated to look like catapults that were actually used in battle, design based on selected civilization, etc.).

Criteria	10	15	20	Score
Eye Contact with Audience	*No eye contact was established during the presentation.*	*Eye contact happened through about half of the presentation.*	*Maintained excellent eye contact throughout the presentation.*	
Organization of Content	*The content was organized in a manner that was very difficult to understand.*	*The content was organized in a manner that was very easy to understand.*	*The content was organized in a manner that was very easy to understand.*	
Quality of Visual Aid	*The visual aid did not clarify the principles and/or demonstrate how the project works.*	*The visual aid contributed to the presentation, although more integration could be useful.*	*The visual aid served a great purpose in the presentation, allowing the judges to understand how the machine works.*	
Teamwork	*The presentation was dominated by one person.*	*Several people presented, but there were some who did not contribute much.*	*Every student presented equally.*	

- **Tie breaker:** In the event of a tie the winner will be determined by lower material cost

References

[1] Farrar, Emily J, and Jonathan T Butcher. "Valvular heart diseases in the developing world: developmental biology takes center stage." *The Journal of heart valve disease* vol. 21,2 (2012): 234-40.

[2] Specifications adopted form: https://www.teachengineering.org/activities/view/van_heartvalves_lesson02_activity1 and https://www.teachengineering.org/activities/view/cub_heartvalves_lesson01_activity1