KU School of Engineering

High School Design

-2023 Rules Packet-

Competition Day: October 25th, 2023

Hosted by the University of Kansas School of Engineering

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General Information

Scholarship Details:

For each of the six competitions, the winning team will receive a $2,000 University of Kansas tuition scholarship. This scholarship will be divided between all winning team members equally. Scholarships will be contingent on student(s) enrolling at the University of Kansas. 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 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.

General Rules:

- Must be currently enrolled as a full-time student in an accredited High School curriculum to compete.
- Maximum team size: 5.
- All work presented must be your own. Outside resources must be cited. Plagiarism will not be tolerated.
- Must have a detailed budget available for judges on competition day. If you are not purchasing materials to compete, estimate the cost of non-purchased items.
- All team members must be registered before the competition, providing all required information and documentation (all explained on the registration form).
- All teams competing in the High School Design competition must complete registration by OCTOBER 6th.
- All project work must be submitted in the timeframe specified by the specific competition rules.
- Constructive feedback will be provided to all teams present, regardless of winning or losing.
- Team name: Each team must have a unique and appropriate name that is not offensive or discriminatory.
- Teams are required to have a teacher or mentor who serves as an advisor/coach for the team.
- Each participant is only allowed to compete in 1 competition.
- **Teams will compete in person at the University of Kansas School of Engineering on October 25th, 2023.**

HSD Code of Conduct:

Each team member and mentor must agree to abide by the code of conduct.

1. Respectful behavior: All participants must treat each other with respect and courtesy, regardless of their background, ethnicity, gender, religion, or sexual orientation.
2. Non-discrimination: All forms of discrimination, including harassment, bullying, or intimidation, are strictly prohibited.
3. Ethical conduct: All participants must uphold the highest standards of ethical conduct, including honesty, integrity, and fair play.
4. Safety: All participants must follow the safety guidelines established by the competition organizers, including wearing appropriate protective gear and following safe practices when working with tools or equipment.
5. Intellectual property: All participants must respect intellectual property rights, including copyrights, trademarks, patents, and trade secrets, and must not engage in any form of plagiarism or misappropriation of others' work.
6. Professionalism: All participants must behave professionally, including being punctual, prepared, and attentive during all competition events.
7. Sportsmanship: All participants must exhibit good sportsmanship, including accepting the results of the competition with grace and respecting the judges' decisions. Detailed feedback for all teams will be provided.
8. Compliance: All participants must comply with the competition rules and guidelines, as well as any applicable laws and regulations.

9. Consequences: Any violation of this code of conduct may result in disqualification and dismissal from the competition.

Important Dates:

Registration Opens	May 1st, 2023
Registration Closes	October 6th, 2023
Competition Day	**October 25th, 2023**

Accommodations:

If any students require accommodation to participate, we are dedicated to giving them an equal opportunity to engage in the competition, please reach out to highschooldesign@ku.edu and we will work with you to accommodate your students!

Competition Rules:

The remainder of this packet will include the detailed rules of each of the six competitions. Each student may participate in only one competition. Students may be in teams of 1-5 and each school may enter as many teams as they please. As such, please fill out the team registration survey and liability forms listed on the website!

Questions Regarding Competition Rules:

If students or advisors have questions regarding the competition rules, they may reach out to their respective competition's representative (listed in their corresponding section of rules) and cc highschooldesign@ku.edu. Please be patient as our competition is run by full-time students, so if you do not hear back within 3 days, please send a follow-up email.

Competition Leads:

- Aerospace – Kieran Egan & Luke Shaw | kieran.fo.egan@ku.edu & luke.shaw@ku.edu
- Bioengineering – Bhavik Goplani & Taylor Slade| bhavik@ku.edu & taylorslade@ku.edu
- Civil – Luisa Ortega & Devon Darst | self.civilcomp2023@gmail.com
- Chemical – Daniel Tabaka | dtabaka2574@ku.edu
- Computer Science – James Hurd | jameshurd@ku.edu
- Mechanical – Ben Belanger & Luke Hansen | benbelanger@ku.edu & lhansen27@ku.edu

Aerospace Competition

Industry Partner: Garmin

Competition Objectives Overview:

Aerodynamics is the study of the properties of moving air, and in particular, the way in which solid bodies like aircraft and racecars move through the air. Whether it's in the air or on the ground, like a Ferrari F2004 that can reach 200 miles per hour, aerodynamics is essential to maximizing the speed and distance travelled for a given force. The principles of aerodynamics which include lift, thrust, drag and weight are important to consider in this challenge. This competition will allow you to explore aerodynamics as well as other mechanics of flight by constructing a glider that may not be as fast as a Ferrari but depends on the same principles to achieve your goal.

The primary goal of this competition is to create a glider that can travel as far as possible in a straight line. The glider will launch by sliding off a ramp positioned above the ground so that the initial force applied to all gliders is equal. Overall, the competition will consist of this test flight, a head-to-head single elimination flight distance tournament, and a 3-5 minute presentation that will cover your design plan, costs, challenges you faced along the way, and how you overcame them. A panel of aerospace industry representatives and aerospace engineering students will be present for the flight tests and the presentation. Details of each part of the competition are given below.

1. Distance:

This category measures the glider's distance from the launch site. The key to this section is to find a balance between the glider's horizontal velocity and airtime. Teams will have only one flight for distance during this part of the competition. The team's score for this test will be ranked and used to assign seeds for the head-to-head competition.

2. Head-to-Head Competition:

This category will test your glider's ability to travel further than one other team in a head-to-head single elimination competition. Each team will be sorted into a bracket with all the other teams in the Aerospace competition. In each round that a team advances, they will be matched up against another glider in a "drag race." The winner will be solely determined by the greatest flight distance. The winner will move on until there is a champion, who will receive the maximum number of available points for this competition. All other teams will be scored based on the round in which they were eliminated.

A secondary factor that is important for this test is durability. Although you will not receive a score directly for the glider's durability, each glider will be tested a minimum of two times (once in the distance test and once in the first round of the tournament) with a potential for more flights, depending on your success in the tournament. The glider will be landing on a wooden gym floor, therefore hard landings may result in

damage to the glider if it is not prepared for these landings. If a glider is damaged and unable to fly, it will be considered eliminated from the tournament.

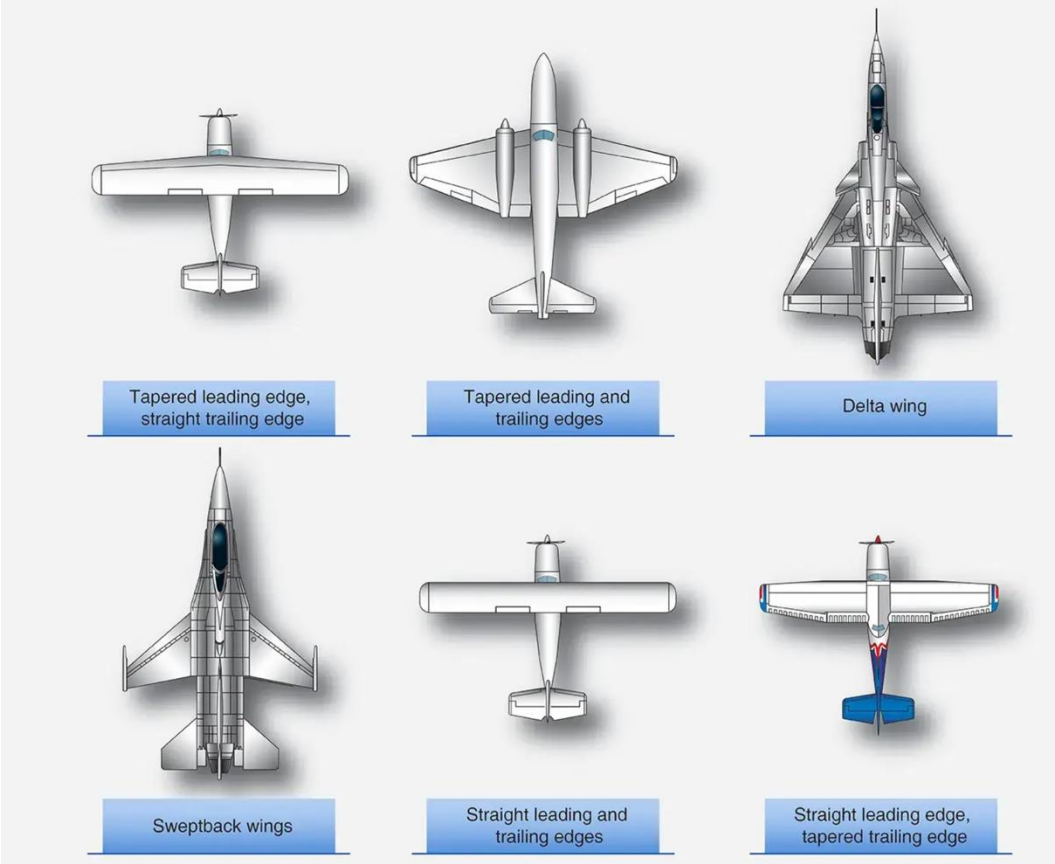
3. Presentation:

The presentation section will be a chance for each team to show off their professional skills. Each presentation will include the design process for the glider, the cost of the product, and the challenges that each team faced along the way. Afterward, our judges will ask questions from a predesignated pool. Scores will be based on presentation quality, responses to questions, and overall team professionalism.

Vehicle and Material Specifications:

Specifications for Vehicle:

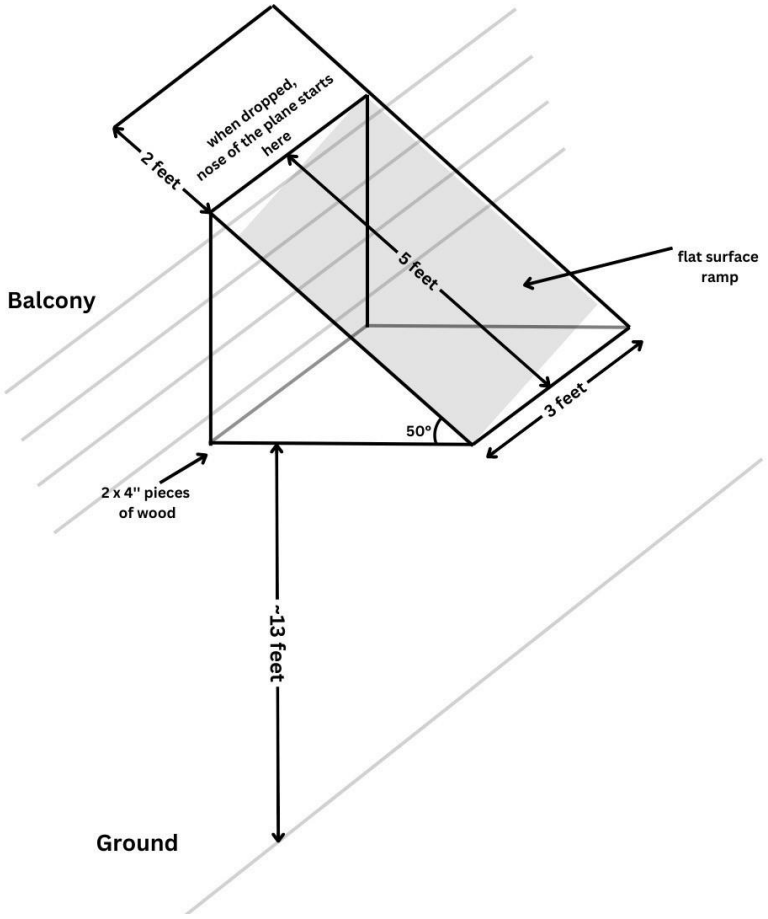
1. Vehicles must be designed and built by a team of students without the use of kits or outside assistance. Note: components/materials from kits are allowed such as Lego wheels for example, but the construction must be an original design.
2. Vehicles must be identifiable as gliders and demonstrate glider flight. For example, no baseballs, frisbees, bean bags, or other similar vehicles are allowed.
3. Vehicles must not return to the launcher (boomerang).
4. There is no material requirement, but the vehicle MUST not contain any dangerous materials such as sharp edges that could puncture someone or something (for example the tip of a dart), chemicals, heavy wood/metal etc. that could cause bodily harm or damage to the test site (a wooden gym floor). When the vehicle lands, the plane should not mark or damage the wooden gym floor on which it will land.
5. No paper airplanes are allowed. Competitors are allowed to use paper in their designs, but it must be their own original design, not just a folded piece of paper.
6. No power sources such as rubber bands, motors, or propellers may be added to the aircraft.
7. The total wingspan must have a length above 2 feet and below 4 feet.
8. No dimension must exceed 4 feet, including wingspan, fuselage length, and any other part of the glider. Think of this rule as if you had a 4-foot by 4-foot box, your glider should be able to fit within it.
9. Must have a weight under 5 lbs.
10. The aircraft must not be deformed during flight, (for example, deployed parachutes, unfolding wings, etc.)
11. Judges and coordinators reserve the right to disqualify any vehicle that violates the spirit of the competition or exemplifies unprofessional behavior.
12. The glider must have wings. There are many different types of wings, but they must be attached directly to the fuselage and fit the required dimensions. The diagram below shows 6 examples of acceptable glider designs. Note: the number of wings may vary as long as the dimensions meet the specifications.



https://www.aircraftsystemstech.com/p/wings-wing-configurations-wings-are.html

Specifications of Release Ramp:

New to the competition this year, gliders will be released down a 50-degree ramp. This ramp is positioned so the lowest point is 13 feet off the ground. In addition, staff and volunteers will be the "launch technicians" this year. Students will not be releasing their own gliders to prohibit gliders from being pushed or propelled down the ramp. The launch technicians will simply release the glider down the ramp. The gliders must fit on the ramp without any special modifications. The ramp will be made from a vinyl plastic material. Students should design their planes to easily move down the ramp. The aerospace competition team is not responsible if a plane cannot make it down the ramp due to unnecessary friction caused by the glider. We want to see innovative designs that utilize the full potential of the ramp, so creativity is encouraged.



What to Bring on Competition Day:

Your team is expected to have your vehicle complete prior to your arrival at the University of Kansas. All materials brought in will be inspected to make sure they meet the required specifications listed above. All materials that do not pass inspection will not be allowed in the competition. Items brought to repair your vehicle can be utilized between tasks but not between back-to-back launches. *In the case of a disqualified launch, see competition procedure below.

A list of what materials to bring on competition day:

1. Your vehicle
2. Your presentation
3. The total bill of materials/itemized project budget
4. Any materials needed for repairs

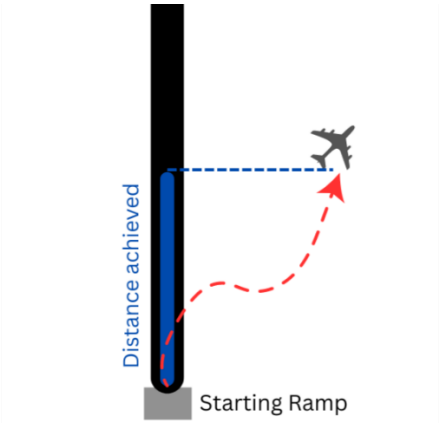
Competition Procedure:

Distance

1. In the initial single flight test, teams will each be allowed one successful launch attempt. All launches are considered successful except if:
    a. A vehicle collides with any other objects while in the air (people, other vehicle)
    Or:

b. A glider gets stuck to the ramp and does not touch the ground.

2. The distance will be measured from the baseline to the nearest point on the vehicle when it comes to a complete stop (via straight measurement on the ground). The distance measurement will not consider any deviation to the left or right but will be measured according to the straight measurement line (see diagram below).



If a launch is deemed unsuccessful, the team will have a chance to redo that test. This is the only case in which a redo will be allowed.

Students will have time to repair any damage done to their vehicle between tasks, but not between tests in the case of an unsuccessful launch. The repairs must not alter the original design of the vehicle, only repair damages sustained within the competition.

Head-to-Head:

1. Two gliders will be positioned on the ramps side by side in their respective lanes and behind the starting lines.
2. All judges and competition officials will be asked for confirmation that they are ready to proceed.
3. If a team is not ready to begin but is present at the location, a timer will begin.
4. If a team fails to provide their glider for the competition, a 2-minute timer will begin. Should that team fail to present their glider within two minutes, they will automatically forfeit their head-to-head competition and their opponent will be given an uncontested victory and move on to the next round (in this case the winner by default may still test their glider if they would like).
5. Assuming both competitors present their gliders on time, the two technicians will position the nose as marked by the team directly behind the starting line on the ramp. The glider will be placed against the ramp, and no special instructions are given to the launch technicians.
6. After confirmation that the judges are ready to proceed, the primary judge will count down from 3.
7. When the judge says "Go," the technicians will release the gliders down the ramp without a push and allow the gliders to travel without interference. If one glider is released slightly earlier/later than the other, that will not impact the decision because the only scored metric is distance.
8. The team whose glider travels the furthest after coming to a complete stop will be allowed to advance to the next round.

Rules and their consequences:

1. Participants must not interfere with the launching of their glider or the measuring process. A failure to abide by these rules will result in a potential disqualification. If the opposing team (the team that did not break the rules) wins that head-to-head race, then they are automatically chosen to advance to the next round. If they lose the head-to-head race, and the at-fault team wins, then the race is redone. If a team breaks the same rule back-to-back, they are automatically disqualified, and the opposing team will advance (this is applicable for every rule within the head-to-head test).
2. If there is contact made with the opposing team's glider, a re-race is necessary to determine the victorious team. If the collision causes a structural[1] change to any glider, the teams will have five minutes to repair their glider and re-race.

Presentation:

The presentation must include:

1. Name of all team members and team name in a title slide.
2. An explanation of a prototyping process and/or design process.
    a. This may include a drawing of a projected design or a few prototype gliders.
3. A list of all materials used, including cost and total cost.
4. The dimensions of their glider.
5. An explanation of why the team chose their final design.

Students are welcome to add any more information about their glider if the presentation remains within the 3–5-minute window and is relevant to the competition.

The students will bring their posters or submit their presentations by email to kieran.fo.egan@ku.edu the night before the competition. The students will be given 3-5 minutes to present, and judges will make notes and ask questions after the student has completed. The judges will pull questions from a list of pre-determined topics, curated by the aerospace competition team prior to the event day.

Scoring:

Distance: 40%

The distance competition will be completed and scored prior to the head-to-head event. The scores for this competition will be used to rank teams for the head-to-head bracket. The distance score is measured from the base of the court at a 90-degree angle to the end of the ramp. From there, the horizontal displacement is measured from the closest part of the glider (when the glider comes to a complete stop) to the baseline. The points awarded will be based on the maximum distance scored by any team during the distance competition. Thus, if your team reaches the farthest distance, your distance will be assigned the "max distance." If there is a tie, the team with the smaller wingspan will receive the higher ranking for the head-to-head competition.

Awarded Points Formula:

$$\frac{Your\ distance\ (ft)}{Max\ distance\ (ft)} \cdot 40$$

Head-to-Head: 50%

[1] Structural change refers to any alteration that affects the glider's ability to fly, performance in the distance competition, and cannot be fixed in the 5 allotted minutes (at the judges discretion).

The head-to-head competition scoring is based on your final performance in the bracket. For example, if you make it to the second to last round, your position will be 3 (1st place is the champion at position 1, and 2nd place is the runner-up at position 2). Every team that is eliminated in the same round will receive the same number of points as one another.

Awarded Points Formula:

$$\frac{4 + number\ of\ teams - 4(your\ position)}{number\ of\ teams} \cdot 50$$

Presentation: 10%

The scoring categories for the presentation include content, organization, professionalism, and question response. The descriptions for each category are as follows:

1. Content: The presentation must include information about your design process for creating your glider, the materials, cost, and labor for creating your design, and any other information about your preparations for the competition. We want to know what you have learned and will take away from this event.
2. Organization: This includes the visual aid. Your presentation and all visual aids should be concise and purposeful. In addition, the presentation should flow in a linear progression and make logical sense to the judges. Graphs, diagrams, and pictures are encouraged to enhance your presentation.
3. Professionalism: As an engineer, professionalism is of the utmost importance, especially when submitting designs to clients. We want you to treat the judges like professional clients. This means being respectful, friendly, and attentive. The second part of this category includes presentation skills. The judges will be looking for eye contact, proper pronunciation, and normal talking speed. We expect all team members to talk equally throughout the entire presentation.
4. Question Response: The judges will ask questions at the end of each presentation. These questions will be used to clarify any ambiguous ideas, test your ability to interpret the results of the distance and durability test, and enquire into how you might approach this competition if given another chance. The judges will not be trying to trick you. They simply want to learn more about your project and what you will take away from this experience.

Scoring Categories	Not Present	Needs Much Improvement	Adequate	Proficient	Excellent
Content	0%	40%	60%	80%	100%
Organization	0%	40%	60%	80%	100%
Professionalism	0%	40%	60%	80%	100%
Question Responses	0%	40%	60%	80%	100%

The final presentation score will be an average of all category percentages multiplied by 10. For example, if someone scores 60% on content, 100% on organization, 80% on professionalism, and 80% on question response, their score averages 80%. This means they receive 8 points from the presentation category.

After all the tests have been completed, the points will be added up and a winner will be declared. In the case of a tie, the team with the greater distance in the distance test will be chosen as the winner of the aerospace competition. If a tie remains, the head-to-head competition results will decide the winner, followed by the professionalism category of the presentation score.

Research Sources and Final Tips:

Below we have provided a few sources that may be beneficial before you start your endeavors. As with all engineering projects, it is important to perform adequate research into the challenge, before building a design. We encourage you to take notes, draw sketches of your designs, and create prototypes before building a physical model. Including that in the

presentation shows that you put significant forethought into the design of your glider. Lastly, we are here to help you be as successful as possible without completing the competition for you. If you have any questions or concerns don't hesitate to reach out. Good luck and don't forget to have fun!

- Nasa: "What is Drag?"
- Nasa: "Lift to Drag Ratio"
- FAA: "Aerodynamics of Flight"
- Harv's Air Service: "Intro To Design Of The Wing"

Contact Information:

For questions regarding competition rules and specifications, please contact:
Luke Shaw and **Kieran Egan** | luke.shaw@ku.edu kieran.fo.egan@ku.edu

Bioengineering Competition

Industry Partner: ScriptPro

Problem Statement: Scenario & Prompt:

"You are part of a team of biomedical engineers tasked with creating a low-cost dialysis machine that can filter simulated blood as accurately, quickly, and efficiently as possible. Your team will compete against other teams in a race to see who can quickly and efficiently filter the simulated blood while maintaining accuracy and safety standards. The team that designs and builds the most efficient and effective dialysis machine will win the race and be awarded the grand prize. Are you up for the challenge?"

Background:

What is dialysis?

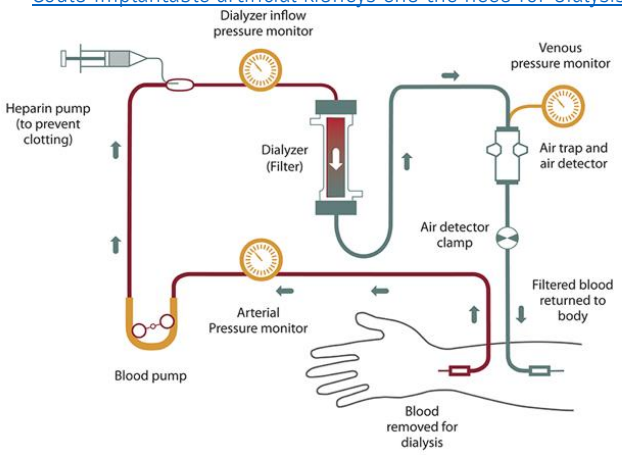
Dialysis is a life-sustaining treatment that removes waste and excess fluids from the blood when the kidneys cannot perform this function adequately. However, the cost of dialysis treatment can be prohibitively expensive for many people, and the lack of access to this essential medical service can be life-threatening. Bioengineering can solve this problem by developing low-cost, portable, and efficient dialysis systems that can provide life-saving treatment to people in need. Artificial kidneys have been in research over the past few years that hope to offer a dialysis-free life by simulating the essential functions of a kidney.

Useful Links:

Dialysis in a nutshell

Game-changing artificial kidney, now in development, offers hope for dialysis-free life

Could implantable artificial kidneys end the need for dialysis?



Source: National Institute of Diabetes and Digestive and Kidney Diseases

Learning Objectives for Students:

- Understand the principles of dialysis and how it works to separate molecules based on size and charge.
- Be familiar with different materials that can be used for dialysis and their properties.

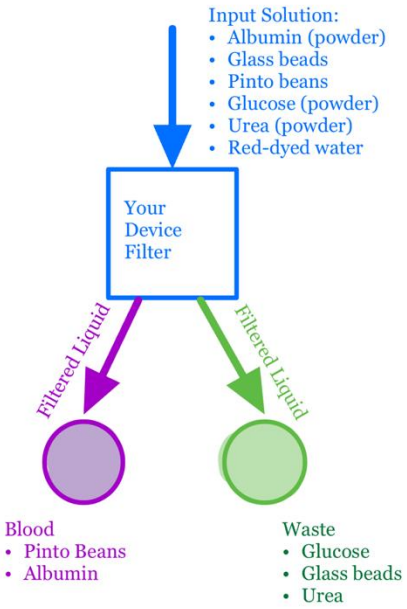
- Develop problem-solving and critical thinking skills to design a system for separating different substances using available materials.
- Learn fundamental laboratory techniques, including measuring and mixing solutions, analyzing experimental data, and drawing conclusions about the properties of tested substances. This will help you gain valuable experience in scientific experimentation.
- Understand the applications and importance of dialysis in medicine and biotechnology, including treating kidney disease and purifying biological molecules.
- Develop teamwork and communication skills by collaborating with peers to design and execute experiments and present findings.
- Build an appreciation for the scientific process and the role of experimentation in advancing knowledge and solving real-world problems.

Deliverables:

1. Low-cost dialysis system based on the requirements outlined below.
2. Printed Excel sheet with the supply chain of materials and cost-breakdown of each component (with receipts or an itemized list of supplies)
3. Ensure that you read the rubric carefully since you will be awarded points based on the rubric.
4. Presentation to the solution (email the presentation by October 24th, 11:59 PM, to bhavik@ku.edu). You can also bring a poster or slides for the presentation on the day of the competition.

Requirements:

1. Simulated blood will be used for testing: water with red dye. The components of the simulated blood are as follows:
    a. Glass beads represent creatinine.
    b. Pinto beans represent red blood cells.
    c. Egg white powder (albumen) represents albumin proteins (soluble).
    d. Glucose (soluble)
2. Heating equipment will not be provided.
3. Readily available kits such as filter kits are not allowed.
4. Dialysate for your dialysis system will not be provided.
5. Use of pumps and motors allowed.
6. Maximum Budget: up to $100. If you purchase a material that is $20, but only use half of that material in your final dialysis system, you can say that it was $10. The final cost does not include prototyping or any other testing costs.



Note: Final location of Red-dyed water will not be judged.

Competition Phases:

Demonstration & Testing Phase

During the demonstration and testing phase of the high school biomedical competition, participants will showcase their prototypes of the low-cost dialysis machine they built using readily available materials. This phase will focus on evaluating the prototype's functionality and how well it performs in filtering out waste products from the simulated blood.

In this competition, the dialysis machine prototype should be able to filter glass beads that represent creatinine, while beans would represent all the blood cells. Egg white powder (soluble in water) would represent albumin proteins, and glucose would represent other metabolic wastes. Beans should pass back to the patient through the simulated blood and egg white powder. The rest of the waste products would form urine that should be disposed of.

We will give you 30 minutes for testing. Testing starts when you pour our provided impure simulated blood containing all the 5 components mentioned above. Once the two cups we provided (look below in things provided) have the waste and pure blood, respectively at the end of the 30 minutes, we will perform the testing as follows:

Parameters for testing:

- Test Kits (glucose strips and albumin strips) would test the filtered blood for the concentration of glucose and albumin, respectively. Check the rubric for further details.

Things we will provide:

- Testing solution – impure simulated blood (water + dye) of 100 ml with the amount of each as follows:
  - Pinto Beans: 20 (count) (Used for Testing)
  - Glass Beads: 10 grams (Used for Testing)
  - Glucose: 3 grams (Used for Testing)
  - Egg White Powder: 1 gram (Used for Testing)
- Two cups: one for waste solution and the other for pure simulated blood, as shown in the diagram above. (Dimensions = 16 oz)
- Test strips we will use:
  - Glucose Test Strips: Amazon Link
  - Albumin Test Strips: Amazon Link

Presentation Phase

1. Design Overview: Participants should provide an overview of the design of their dialysis system, including the materials used and their cost, and the system's key components. Participants should explain how their design addresses the requirements of the competition, including affordability, effectiveness, and simplicity.
2. Operation: Participants should demonstrate how their dialysis system operates, including how the simulated blood is circulated through the system.
3. Results: Participants should present the results of their testing phase before the competition and demonstrate how their dialysis system performed.

It's important to note that participants should aim to keep their presentations clear, concise, and engaging. Participants should limit their presentation to 5 to 7 minutes. Additionally, participants should be prepared to answer questions from the judges about their dialysis system. The students will bring their posters or submit their presentations by email to bhavik@ku.edu by October 24th, 11:59 PM, before the competition.

Judging Criteria/Rubric:

Presentation: 10% | Demonstration: 75% | Design: 15%

Criteria 1: Presentation (10%)

1. Time & Organization (5%): The presentation is well-structured, with the time limit kept in mind and easy to follow, with clear and concise explanations of the dialysis system design and operation.
2. Content and Creativity (5%): The presentation demonstrates a creative and innovative approach to developing a low-cost dialysis system while effectively addressing the problem statement and requirements of the competition.

Criteria 2: Demonstration and functionality on the day of the competition (75%)

1. Functionality and Accuracy (60%): The dialysis system demonstrates effective filtration of simulated blood.
2. Efficiency and durability (5%): The dialysis system operates efficiently and consistently, with no major malfunctions or breakdowns during testing or the demonstration.
3. Human Interaction with System (10%): After pouring the initial simulated blood, the dialysis system functions with little to no human interaction. (Mechanical intervention will not deduct from this section of scoring.)

Criteria 3: Engineered Design (15%)

1. Cost and Accessibility (10%): The dialysis system is designed with affordability and accessibility, utilizing readily available materials and components that can be sourced at low cost (up to $100).
2. Technical Design & Safety (5%): The dialysis system design is technically sound and effectively addresses the requirements of the competition, including filtration efficiency, the accuracy of detection, and ease of operation. The dialysis system is designed with appropriate safety and ethical considerations in mind.

Each sub-criteria will be scored on a scale of 1-5, with 1 being the lowest and 5 being the highest. The overall score for each criterion will be calculated as a percentage of the total possible points for that criterion. Then the final score for each participant will be calculated as the weighted average of the scores for each criterion.

Rubric Presentation:

Sub Criteria	Description	Scoring

Time and Organization	5 – Stays within allotted time limit of 5-7 minutes; is organized in an easy-to-understand way 4 – Goes slightly over or under time limit; is organized in an easy-to-understand way 3 – Goes slightly over or under time limit; could be clear and more organized 2 – Goes slightly over or under time limit; unorganized and hard to follow 1 – Goes significantly over or under the set time limit; unorganized and hard to follow demonstrates no knowledge of subject	___/5 * 5% = ____
Content and Creativity	5 – Demonstrates a creative and innovative approach; effectively addresses problem statement and requirements 4 – Creative and innovative approach; addresses almost all aspects of problem statement and requirements 3 – Addresses most aspects of problem statement and requirements but does not demonstrate an innovative/creative approach 2 – Missing important/key aspects of the problem statement and requirements 1 – Unoriginal; does not address any or key elements of the problem statement and requirements	___/5 * 5% = ____
Total		____/10%

Rubric: Demonstration and Functionality

Sub Criteria	Description	Scoring
Functionality and Accuracy (filtering)		
Glucose	5- 0 mg/dL concentration detected in the filtered blood 4- 1-100 mg/dL concentration detected in the filtered blood 3- 101-300 mg/dL concentration detected in the filtered blood 2- 301-1000 mg/dL concentration detected in the filtered blood 1- 1001-3000 mg/dL concentration detected in the filtered blood	____/5
Creatine (Glass Beads)	5- 0 grams of beads left in filtered blood 4- 1-2 grams of beads left in filtered blood 3- 3-6 grams of beads left in filtered blood 2- 7-9 grams of beads left in filtered blood 1- 10 grams of beads left in filtered blood	____/5
Albumin (Egg White Powder)	5- 10 g/L concentration left in filtered blood 4- 3.0 g/L concentration left in filtered blood 3- 1.0 g/L concentration left in filtered blood 2- 0.3 g/L concentration left in filtered blood 1- 0 g/L concentration left in filtered blood	____/5
Blood (Pinto Beans)	5- 20 beans left in filtered blood 4- 15-19 beans left in filtered blood 3- 10-14 beans left in filtered blood 2- 5-9 beans left in filtered blood	____/5

	1- 0-4 beans left in filtered blood	
Total		___/20 * 60% = ___
Efficiency and durability	5- Efficient and consistent with the filtering test, no breakdowns, or malfunctions 4- Minor malfunction the test, no significant effect on the output 3- Minor malfunctions for the with some impact on the outcome (system still filters most objects representing substances to be filtered out) 2- Minor malfunctions that have major impacts on the outcome (does not filter most of the contaminants) 1- Major malfunctions (results in no proper filtration of the substances to be filtered out)	___/5 * 5% = ___
Human Interaction with System	5- No human interaction necessary for device to work (mechanical mechanisms allowed) 4- 1 small interaction necessary for device; (example: manually moving a valve or switch) 3- Moderate amounts of interaction needed at various stages of testing process (2-3 times) 2- Several interactions needed to operate device (4+ times) 1- Device is completely dependent on human interaction (constant interaction); cannot function in any capacity without it	___/5 * 10% = ____
Total		___/75%

Rubric Engineering Design:

Sub Criteria	Description	Scoring
Cost and Accessibility	5- The design is <$100 4- The design <$105 3- The design is <$110 2- The design is <$115 1- The design exceeds $120	___/5 * 10% = ___
Technical design & Safety	5- Technically sound and effectively addresses all requirements including efficiency, accuracy of detection, and ease of operation; designed with safety and ethical considerations 4- Addresses most of the requirements, designed with safety and ethical considerations 3- Addresses some of the requirements, accounts for safety and ethics 2- Addresses some of the requirements, does not account for safety and/or ethics 1- Addresses little to none of the requirements for the competition, does not consider safety and ethics	___/5 * 5% = ___

Total		___/15%

Contact Information:

For questions regarding competition rules and specifications, please contact:
Competition Chairs: Bhavik Goplani (bhavik@ku.edu) and Taylor Slade (taylorslade@ku.edu)

Chemical Engineering Competition

Industry Partner: Burns & McDonnell

Challenge Overview:

The day of the big race is almost here! With the design of the racecar nearly complete, there is still one key factor left to address: insulating the engine to protect the driver. Modern-day F1 cars produce nearly 1000 horsepower, and with the car designed to be as light as possible, the amount of heat produced by that much energy can easily transfer to other parts of the car. Your team will create a system to insulate boiling water representative of the heated car engine. The system that you make should be designed and created based on elements that limit heat transfer. The system should be as light as possible, and the team must create a presentation detailing your insulation system that will be given to the senior design board.

Competition Specifications:

1. Total material cost may not exceed $25.00 (This is enforced for material physically used in the build. For example, if a sheet of material costs $20 but only a ¼ of it is necessary for the build, then material cost for the component is $5. Budget is a parameter that will be crucial because, should it come down to a tie between 2 teams, the more cost-effective project will be the winner).
2. Parameters to be tested and scored: weight of thermos system, the initial and final temperature of water in thermos system, cost of materials, and presentation.
3. Thermos systems MUST follow all parameters below explicitly to be eligible for competition. All builds will be analyzed to ensure they meet the proper parameters.

Competition & Judging Procedure:

1. On the day of the competition, the competing team will bring their thermos system into the competition. The thermos must be fully complete, and no changes can be made in any way to the system on the day of the competition.
2. The thermos will be weighed on a scale to determine how light or heavy it is.
3. The water will then be boiled using a kettle and poured into the thermos at which an initial temperature will be taken using a temperature gun.
4. The container will then be sealed by the competition team and left to sit for 15 min in an ice bath to measure heat transfer.
5. During this 15-minute window, the competition team will give their presentation to the judges in which they will discuss the materials used, the reasoning behind each material and concept, real-life research that inspired the build, and a full budget of materials.
6. After the presentation and the 15-minute window, the thermos system will be unsealed, and a final temperature will be taken of the water.
7. The competition team WILL NOT be pouring or coming in any contact with the boiling water being poured into the thermos. The Chemical Competition volunteers for HSD will have access to safety equipment including safety goggles for all competition teams and will be responsible for pouring the boiling water into the system.

What To Bring:

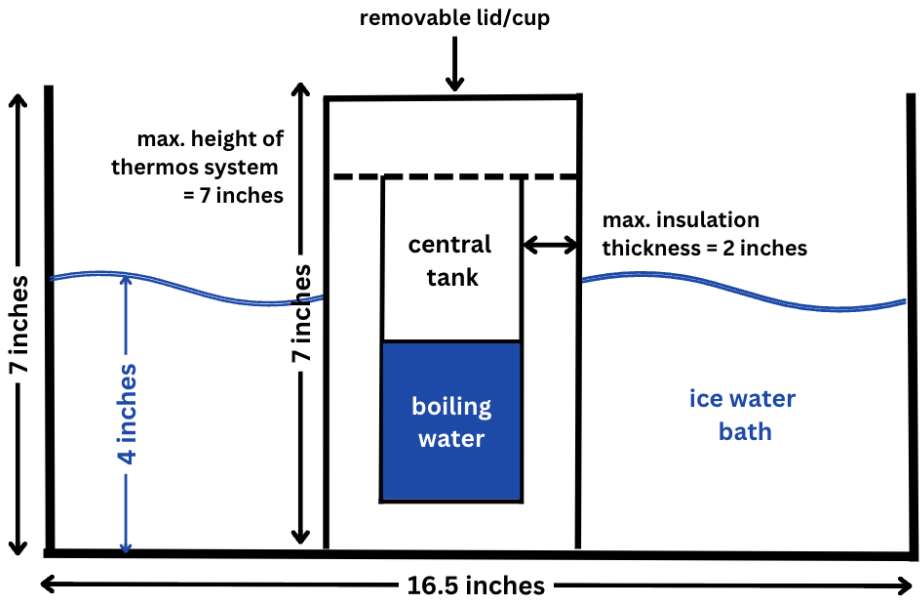
1. Your thermos system* (labeled with a team name and contact info)
2. A printed Excel sheet containing the materials used and the cost of each must be given to us along with your device.
3. Your proposal presentation**

**We will supply a heating element to boil the water, a temperature gun to check the temperature, the water itself to be boiled and placed in the thermos system, the ice-water bath, and a scale to weigh the system*

***Presentations may be emailed to dtabaka2574@ku.edu by October 24th, 11:59 PM. Additionally, competition teams may also bring their laptop to pull up their presentation. Your device must have an HDMI hookup.*

Thermos System Specifications:

1. The thermos system must contain a central tank/container that must safely be able to hold 250mL of boiling water poured into it, and the insulation system will be constructed around this central tank/container. The central tank must be able to safely contain boiling water with no damage, deformation, or melting occurring and must be able to be sealed and unsealed with ease. The tank and insulation system must be one unit with the insulation system being in physical contact with the central tank/container.
2. No fiberglass, Styrofoam, foam of any kind, blow-in insulation, wall insulation, or pre-made insulation materials (insulated water bottles, heat shielding, spray foam, foil insulation, insulated thermoses) may be used ANYWHERE in the build of the project. Builds will be analyzed for restricted materials before testing occurs.
3. Total material cost may not exceed $25.00 (This is enforced for material physically used in the build. For example, if a sheet of material costs $20 but only a ¼ of it is necessary for the build, then the material cost for the component is $5). Budget is a parameter that will be crucial because should it come down to a tie between 2 teams, the more cost-effective project will be the winner.
4. Thermos system must be able to be sealed and unsealed with relative ease due to the need to take temperature measurements and must allow for the boiling water to be poured into the central tank effectively.
5. To maintain equilibrium, all thermos systems will be placed in a container filled with an ice-water bath to maintain a constant temperature on the outside of the thermos. As such, the thermos system must be designed so that water will not leak into it. Whether or not the thermos system will be completely submerged in the water bath depends on the individual team's construction of the system based on the given parameters.
6. The container for the water bath will have dimensions of 16.5 inches in length, 11 inches in width, and 7 inches in height. The container will be filled with an ice-water bath 4 inches high in the container. The height of the team's thermos system MUST NOT exceed 7 inches in height.
7. The thermos system, when placed in the bath, must be in contact with the bottom of the container the water bath is in. Additionally, all 250 mL of boiling water must be below the 4-inch water line of the ice bath. Sections of the thermos are allowed to extend above the top of the water line up to the 7-inch height limit, but NONE of the boiling water contained in the thermos may extend beyond the 4-inch water line.
8. The thickness of the insulation system spanning out from the central container MUST NOT exceed 2 inches in width surrounding the central container.
9. The thermos system must be a passive system with no additions being made to the system before or during heat transfer on the day of the competition. The ONLY THING the competition team will be able to do is place the thermos system in the ice water bath, seal the system with a simple cap/lid after the boiling water is poured, and leave it in the water bath for the designated amount of time for heat transfer with no contact being made to the system by the competition team. The thermos system must be a single unit with no attachments that may sit outside of the ice water bath. No alterations or temperature changes of ANY KIND may be made to the thermos system the day of the competition.
10. The bottom of the physical thermos MUST be in direct contact with the bottom of the ice water bath and cannot be elevated on a stand or legs which would result in the physical thermos being suspended in the air. All other parameters for the size of the thermos system remain the same.
11. No chemical reactions of ANY KIND may take place or be used anywhere in the thermos system. This will be a test of your team's understanding of principles of heat, process design, and ability to make a product follow specifications.



Proposal Presentation:

- The proposal presentation must consist of your reasoning and process for designing the thermos system such as material choice.
- The senior design board wants to make sure any insulation system added to the car will be successful and therefore looking for the exact specifications of the system – how much does the system weigh? Cost of the materials? Amount of each material used. Reasoning behind the use of the components?
- Please include a diagram showing the thermos system and the materials incorporated in it. This must include the placement of the material, how much of each material was used, and why the materials were arranged in that way.
- The board also wants to be efficient on costs. They are looking for an explanation of how the system is cost-efficient while maintaining effectiveness.
- Be sure to cite any sources used.
- Presentations should be between 5 and 8 minutes in length to allow for Q&A from judges, and all team members should participate.
- See the rubric below for full scoring.

General Scoring Breakdown:

100-point total

Category	Description	Total Points
Heat Transfer	Effectiveness of overall effectiveness of thermos system at preventing heat loss; 1 point deducted for every degree of temperature lost from initial temperature to final temperature; ex. For an initial temperature of 100 degrees Celsius and final temperature of 75 degrees Celsius, total points will be 45/70	__/70 pts max.

Category	Description of point differentiation	Total Points

Dry weight of overall thermos system	Dry weight of thermos system is greater than 5 pounds: 0 points awarded	Dry weight of thermos system is greater than 2 pounds and less than or equal to 5 pounds: 10 points awarded	Dry weight of thermos system is less than or equal to 2 pounds: 20 points awarded	__/20 points max.

Category	Scoring Breakdown			Total points for each category
Group Participation	Only one group member participates in presenting: (0 pts)	Some delegation to all group members, majority of presenting still rests on one person: (0.5 pts)	All group members involved in presentation and are active: (1 pt)	__/1
Diagram of thermos system	No diagram of thermos system given in presentation: (0 pts)	Diagram of thermos system given; very little detail and few to no specifications of thermos system provided with materials used: (1 pt)	Detailed diagram given of thermos system; all materials used are labelled and described on diagram with quantities used; full specifications of system are provided: (3 pts)	__/3
Budget	No budget present or incomplete without all materials listed: (0 pts)	Some materials and budget listed; only prices listed without quantity of materials used: (0.5 pts)	Full materials and budget spreadsheet provided with type of material used and quantity used: (2 pts) (MUST HAVE FULL BUDGET IN ORDER TO BE ELIGIBLE FOR COMPETITION)	__/2
Reasoning and understanding of concepts used in thermos build	Gaps in understanding and little to no confidence with the material; unable to explain concepts used in thermos build and reasoning behind materials used: (0 pts)	Basic understanding and some confidence in material; able to roughly explain concepts used in thermos build, still very unclear on some topics: (1 pt)	Expert understanding and confident in the material; able to thoroughly and accurately explain all concepts used in thermos uild and reasoning for each part of the build: (3 pts)	__/3
Citations	No citations present in presentation: (0 pts)	Some citations present, incorrect formatting: (0.5 pts)	Detailed citations present throughout presentation with citation slide; all in proper MLA format: (1 pt)	__/1

TOTAL POSSIBLE POINTS FOR COMPETITION: _____/ 100 PTS

Contact Information:

For questions regarding competition rules and specifications, please contact: Daniel V. Tabaka | dtabaka2574@ku.edu

Civil Engineering Competition

Industry Partner: HNTB

Introduction:

A new building needs to go up as quickly as possible. You and your team will need to build a structure that meets the requirements in 30 minutes or less. This structure needs to be able to stay strong while supporting loads and handling earthquakes.

Your structure MUST follow ALL specifications listed below to compete in the competition. Additionally, there will be three aspects (structural design, presentation, shake table testing) and a bonus opportunity to contribute to the overall grading of your project: 1) Load Testing, 2) Report

Building Process:

- Students will have 30 mins to build their structure **on KU's Campus.**
  - Students should already have plans for their structure. (Presentation)
- Teams will have material provided. (Materials)
  - Teams will be limited to fifteen ¼" x ¼" x 36" balsa wood sticks and 4 hot glue sticks to construct their designs.
  - Be as creative as you want in your design.
  - Students can decide to use all or less of the materials provided.
- Teams can use premade templates to help during the building process.
- **Total height range:** min 34"- max 50"
- **Total width range:** min 6"- max 13"
- **Total length range**: min 6" - max 13"
- Think of the building as a grid of members/skeleton of the building.
- Your structure must have a flat base and top to be taped onto the shake table.

ALL TEAMS MUST START AND FINISH CONSTRUCTION DURING THE 30 MINS PROVIDED. FAILURE TO DO SO WILL LEAD TO IMMEDIATE DISQUALIFICATION!

Materials:

- **MUST ONLY** use the given ¼" x ¼" thickness balsa wood sticks and hot glue for the entire structure.
  - Sticks will be ¼" x ¼" x 36"
- **MUST have a flat AND level top and bottom** with minimum dimensions of 6" in length, 6" in width, and 34" in height, and with maximum dimensions of 13" in length, 13" in width, and 50" in height.
- Provided:
  - 2 hot glue guns and 4 four-inch glue sticks.
  - 2 pairs of scissors.
  - Tape measures/rulers will be supplied to confirm dimensions (teams may also bring their own).
- Can bring:
  - Stencils or blueprints to the competition.
  - Notepads and calculators.
  - Measuring devices such as a ruler and angle measuring devices such as a protractor.
- **Additional hot glue guns are not allowed.**

- No more than 5 students per team

MUST FOLLOW *ALL* SPECIFICATIONS TO AVOID DISQUALIFICATION!!!

Presentation:

The students will be given 3-5 minutes to present, and judges will make notes and have 2 minutes to ask questions after the students have completed their presentation. The judges will pull questions from a list of pre-determined topics, curated by the Civil competition team prior to the event day.

Students are welcome to add any more information about their structure if the presentation remains within the 3–5-minute window and is relevant to the competition.

- Your group will be responsible for creating a presentation explaining the design of the structure and the reasoning for the design.
- Presentations should be emailed to self.civilcomp2023@gmail.com by October 20th.
- The presentation must also contain a blueprint of the design. This can additionally be a handout but does not need to be.
    - Blueprint must have clear dimensions on three different views. (Front view, bird's eye view, side view)
    - Groups must use drafting paper or AUTO CAD for their blueprint.
    - Blueprint must be displayed on an 11" x 8" paper if the team decided to make it a handout.
- Your presentation should include two sustainable/green features and explain why these are beneficial for sustainability.
    - These features do not need to be included in the physical build of your project.
- Your presentation should include a build-day plan that shows preparation.

Judges will be going over your report during your building time following this rubric:

Total Presentation Points Available: 15

	Beginner 1 point	Developing 2 points	Acceptable 3 points	Effective 4 points	Excellent 5 points
Design Explanation (includes explanation of structural choices and research)	Failed to address prompt or only explained one part of prompt.	Slightly addressed design choices.	Addressed some portion of design choices with vague explanations.	Addressed all effectively and with some level of detail. Information on earthquake designs.	Full detail and explanation behind structural choices. Detailed information on earthquake design.
Sustainability/ Green Features	No hypothetical sustainability/ green features explained.	One feature with vague explanation.	One – two features with thorough explanation of how they make the building sustainable.	Two or more features with good explanation.	Two or more features with thorough explanation of their benefits.

Plan for build day.	No plan was given.	Vague description of plan.	Some explanation of plan.	Good explanation of the build day plan.	Fully explains the build day plan, steps and roles of each team member.

Shake Table Testing:

- The structure will be tested on KU's uniaxial shake table.
- Each team will have the mass of their structure taken before testing.
- Loads will be applied to the top of your structure.
    - Loads will be in increments of ½ lb.
    - Loads will be made from Ziplock bags of sand.
- Testing will be performed with 10-sec intervals of shaking before more weight is added.
- Each team gets five minutes to perform 6 tests on the shake table.
    - Teams must start with ½ lb. plus the plywood platform surface on the first test.
    - Teams can choose between two different sizes of plywood to be set on top of their structure:
        - 8"x8"
        - 14"x14"
        - The plywood will not count toward your score.
    - Teams will then decide how much weight they want to add on before their next test.
- Your structure must survive the full length of 10 seconds of shaking to count that amount of weight toward your score.
- The structure will be tested until failure/your structure cannot hold wood on top anymore, or the team with their structure being tested, agrees that the competition should be halted.

Scoring:

- The plywood platform and first ½ lb. bag = 30 points.
    - Each additional half a pound will equal 15 points.
- The point system will be cumulative meaning that for each successful test, your points will be added to your total score. Do your test wisely.
- Your presentation score will be added as a bonus at the end of testing.

Final Grade Breakdown:

- In the case of a tie in overall scores, the team with the lowest mass of the structure will be the winner.

Contact Information:

To clarify civil competition questions, please contact Luisa Ortega or Devon Darst at self.civilcomp2023@gmail.com

Computer Science Competition

Industry Partner: Microsoft

1. A Note on Evaluating Computer Science Projects

Unlike other disciplines of STEM, Computer Science is a field that sits at the intersection of science, engineering, and art. As with any competition that encourages creative freedom, this competition mirrors the subjective nature of the field.

2. Introduction:

In this development challenge, you will take the role of a software engineering firm. A client has come to your firm with a project they urgently need to be completed, however, there is a tight deadline: high school design day. Join me in a race against time to create the best product that fulfills the requirements before the deadline!

3. Problem Statement:

Using a programming language(s) of your choice, design a piece of software to help a student manage their busy schedule. Your software should implement the features given in section 4. In addition, if teams would like to earn bonus points, they may attempt to implement any number of the challenge features given in section 5. These features are not required and will only add points to a team's score if successfully completed. This should be completed before High School Design Day.

On High School Design Day, teams will participate in an on-site mini hackathon (detailed in section 6) to add an additional feature to their software. After the hackathon, teams will demonstrate their software to a panel of judges and be scored accordingly (see section 7).

Hint: For the purposes of the project demonstration (see section 7.1), be sure that all features of your app can work without internet access in case something goes wrong, and you cannot access the web.

4. Project Requirements:

Your software should include the following functionality.

- A way to schedule tasks (e.g., a to-do list) and interact with them in the following ways:
  - Mark tasks as completed.
  - Edit all parts of tasks after they have been added.
  - Associate a due date with each task.
- The user should be able to sort their task list in the following ways:
  - Alphabetically by task title.
  - Newest to oldest created.
  - Closest due date.
- The ability to view how many tasks a user has completed each day for the previous 30 days. The user should also be able to see how many of these tasks were completed on time (before the due date).

5. Bonus Challenge Features:

1. **For three bonus points,** have the application create a "daily update" report which contains the current date and time, a summary of any tasks completed over the past 24 hours, whether they were completed on-time or not, and reminders for tasks that are due in one, three, and five days respectively. The report should be saved as a text (i.e. a .txt) file and be able to be requested by a user on demand at any time.
2. **For six bonus points,** make your app compatible with multiple users, each having its own to-do list. Users should authenticate with a user ID and password. Users should only be able to interact with their own to-do lists.
3. **For fifteen bonus points,** make your application usable through a representational state transfer application programming interface (REST API) using Hypertext Transfer Protocol (HTTP) requests. Specifically, the following functionality should be implemented:
    - GET requests should be used to view uncompleted tasks.
    - POST requests should be used to add new tasks.
    - PUT requests should be used to edit task details.
    - DELETE requests should be used to mark tasks as completed.

All returned data returned by the API should be serialized using JavaScript Object Notation (JSON). If a team also decides to implement feature 2, separate users may be specified using either HTTP request headers or different endpoints, authentication is not needed.

6. On-site Mini Hackathon:

In addition to the features detailed in section 4, there will also be a mystery feature that teams' software should include that will be announced on High School Design Day. There will be several options for the mystery feature that varies in difficulty. Teams will choose one mystery feature to implement. Successfully implementing a more difficult mystery feature will reward a team with more points, but there is also potential for earning less points if a team fails to implement the feature as opposed to if they had successfully implemented an easier mystery feature (see section 7.3.1). The only hint that will be given about the mystery features, is that one or more will involve file input and output, so be sure to design your project with these things in mind.

One hour before the team's project presentation (see section 7) begins, they will receive an email disclosing the mystery features and point values. The team should reply with which mystery feature they select (**you may only select one**).

You will be notified of the exact time to expect the email of the mystery features on the day before High School Design Day. Since teams will be competing against each other, it is in their best interest not to share the features with others. There will be a special room where teams can work on their implementation away from other groups who may not know about the features yet.

No resources will be provided besides access to KU's guest Wi-Fi. If you are relying on remote resources (e.g. servers in the cloud) it is not guaranteed that you will be able to access these during high school design day. Keep this in mind when designing your project. If you will be using a school computer, make sure it can access other public Wi-Fi networks if internet access is required to work on your project. If a team is unable to bring a computer to work on their project during this part of the competition, please contact James Hurd (see section 8.2) as soon as possible.

7. Project Demonstration and Scoring

7.1 Project Demonstration

After the on-site hackathon (see section 6), teams will present a three to five minute live demonstration of their software product to a panel of judges. The demonstration should showcase all initially required features of the product (section 4), their implementation of the mystery feature (see section 6, and any challenging features they decide to implement (see section 5).

Teams will use their own devices to demo their software. Presenting off of a laptop and/or handheld electronic device is perfectly acceptable, as long as your app and source code (see section 7.2, 1) can be demonstrated using these devices. If you will be unable to demo using your equipment, please contact James Hurd (see section 8.2).

Laptop chargers will not be provided, and wall power outlets will not be available outside of the hackathon room. Therefore, it is the responsibility of the team to make sure they bring any chargers they may need and that their devices are fully charged for the demonstration.

Hint: For the project demonstration (see section 7.1), be sure that all features of your app can work without internet access in case something goes wrong, and you cannot access the web.

7.2 Q&A

After the demonstration, the judges will have the opportunity to ask the team any questions they may have about their project. In addition to project-specific questions, the judges will ask the team to do the following:

1. To show the source code for a chosen feature of their app and walk through how the code works. The feature will be withheld until the team demonstrates their project.
2. The judges will give teams several test cases for them to run on their app.

7.3 Scoring

Teams will be scored on their demonstrations (section 7.1) and answers to questions (section 7.2) by the rubric given in section 7.3.1. Judges will also be able to award partial credit outside of the specific point categories given in the rubric. The team with the highest score will be deemed the winner. Each judge will fill out a rubric and their scores will be averaged to yield a team's final score before bonus points. For each challenge feature that a team implements (section 5) they will be awarded the corresponding number of bonus points to determine their final score. In the event of a tie, design aesthetics (i.e., Creativity, consistency, and cleanliness in choice of colors, fonts, etc.) will be used to break the tie.

7.3.1 Rubric

Criterion	Outstanding	Exemplary	Satisfactory	Needs Work
Initial Requirements (Section 4)	Project addresses all initial requirements in a creative and user-friendly fashion. **(25 points)**	Project addresses all of the initial requirements. **(20 points)**	Project address two of the initial requirements. **(15 points)**	Project only addresses one or none of the initial requirements. **(10 points)**
Source Code Understanding (Section 7.2, 1)	Code is self-documenting and well-organized. Team can fully explain all parts of the logic behind their code. **(20 points)**	The team can fully explain all parts of logic of the feature. **(15 points)**	The team can partially explain the logic of the feature. **(10 points)**	The team cannot explain any of the feature logic. **(0 points)**
Surprise Feature[2] (Section 6)	The team fully implements the mystery feature with no bugs. **(n points)**	The team fully implements the mystery feature, but bugs are present. **(n−2 points)**	The Team partially implements the mystery feature. **(⌊n/2⌋ points)**	The Team fails to implement any portion of the mystery feature. **(3 points)**
Live Demonstration (Section 7.2, 2)	All the test cases function as expected. **(20 points)**	Two-thirds of test cases function as expected. **(15 points)**	One-third of test cases function as expected. **(10 points)**	Less than one-third of test cases function as expected. **(5 points)**

[2] *n* represents the number of points the chosen surprise feature is worth

Q&A (Section 7.2)	The team can fully answer all the judges' questions. All team members contribute to answers. **(15 points)**	The team can fully answer all questions, but not all team members contribute to answers. **(10 points)**	The team can partially answer all of the judges' questions. **(7 points)**	The team is only able to answer some of the judges' questions. **(3 points)**
Presentation Skills	The team presents their product with enthusiasm in an easy-to-understand manner. All team members are active participants in the demonstration. **(5 points)**	The team clearly presents their product, but they lack enthusiasm. All team members are active participants in the demonstration. **(4 points)**	The team clearly presents their product, but not all team members actively participate. **(3 points)**	The presentation of the product is unclear and hard to follow. **(1 points)**

8. Housekeeping

8.1 Cheating

Cheating will not be tolerated in any form. Cheating includes, but is not limited to, the following:

- Using open-source code you did not write and claiming it as your own.
- Having an individual outside of your team make major contributions to your project's codebase.
- Recycling code from a previous project.

If a team is caught cheating, it will result in immediate disqualification from the competition.

8.2 Contact Information

If you have any questions or concerns, please contact James Hurd (jameshurd@ku.edu).

Mechanical Engineering Competition

Industry Partner: Argus Consulting

Overview:

This competition focuses on the principles of mechanical engineering including forces, weight, air flow, kinetic energy, and potential energy. You will build a "dragster" that will be powered by a propeller. The competition will be scored on how far your dragster can go (distance from the start line until it stops) and straightness (how far the dragster goes off the centerline once at rest). Scoring will also include a presentation.

Device Construction Rules

The rules listed below explicitly address legal parts and materials and how those parts and materials may be used on a team's device. The goals of these rules are to create a reasonable design challenge that is safe and fair for all teams. If any rule clarifications are needed reach out to one of the competition chairs listed at the end of this document.

- The Dragster will contain a few key elements: The car frame, the propellor(s), and a source of power for the propeller.
    a. The car altogether, including the propellor and source of power, must not exceed the dimensions of 16 inches long with a propeller(s) vertical, 12 inches wide with a propeller(s) horizontal, and 12 inches tall with the propeller(s) vertical before racing.

    b. The propeller(s) must be the only source of acceleration on the vehicle. The propeller must stay on the car during the testing. No chemical, rocket, electrical, or combustion propulsion is allowed. No axle-driven dragsters are allowed.
    c. The source of power can be reset after each attempt; the use of motors or electric power is prohibited for the source of power or winding of the source of power.
- The Dragster must stay intact and must maintain a point of contact on the ground during each run or the run will be disqualified.
- When the light turns green the car must be released and not pushed forward or accelerated by the team in any way. After release, the vehicle may not be touched until after the race is complete and measured.
- The car frame (including wheels) must be homemade and not be a part of a kit.
    a. For example, using a cd as a wheel is ok since it was not designed as a wheel and is a homemade solution. However, using a wheel that was part of a Lego set would not be ok, since its original purpose was to be the wheel of a vehicle. This is the same idea for the rest of the frame.
- The propellor and source of power (ex. rubber bands) can be purchased or homemade.
- 3D printing is permitted but the file must be designed by the team **and submitted before testing to a competition chair for proof of your unique design.**
- For safety reasons, teams must make sure that their cars do not contain excessive potential energy that could be released in an unexpected or unsafe manner.
- Your dragster must not exceed a total cost of $20.
    a. This is the final cost of the dragster. If you purchase a material that is $20, but only use half of that material, you can say that it was $10. The final cost does not include prototyping or any other testing costs.
- The vehicle cannot exceed 5 lbs.
- Teams may not exceed 5 group members.
- Teams are limited to one vehicle per registration

Testing:

Testing of devices will occur at the KU campus in Burge Union Forum A. Teams will be given 3 attempts to test their dragster. The floor of the competition room which the dragsters will be run on is low-pile classroom carpeting. Teams have 3 minutes in between runs in which adjustments or fixes can be made. At the end of these three minutes, the team must be ready to release their dragster.

The following steps must be completed to complete a successful test:

1. The Dragster will begin behind the start line and within the walls of the racetrack.
2. When the light turns green, the team will release their vehicle.
3. After the dragster stops moving it will then be scored on parameters that are explained later in this document. The run can be deemed a DQ if it breaks one of the rules stated above.

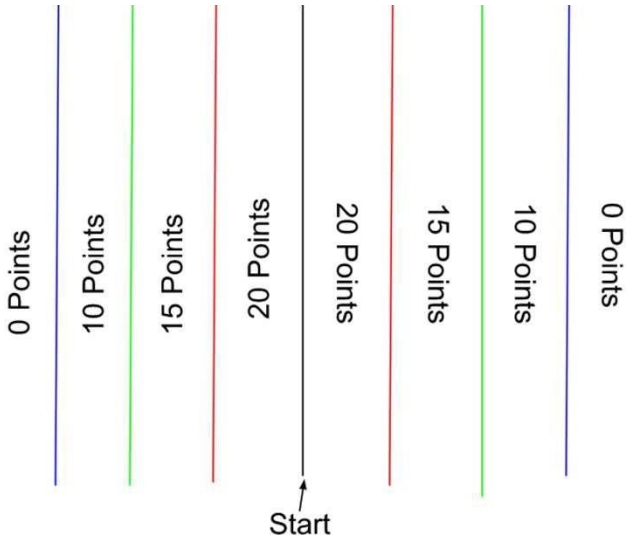
Scoring:

Total score will be calculated based on an equation adding the max distance, straightness of the car, and presentation score. Distance will be measured from the initial front end of the dragster. The distance will have a max of 70 points which one team will earn. The other teams scoring will be based off of the team that goes the furthest. Straightness will have a max of 20 points and is unrelated to how the other teams score. The presentation will be 10 points. The

distance and straightness to be used for your team's final score will be taken from the same run (Ex. You cannot use the distance from one run and the straightness from another to get a higher score) .

L = Length Dragster ran down drag strip (meters)
D = Deviation from the center line (meters)

- The group who travels the furthest down the line will receive 70 points and each other group will receive points based on a percentage of how far their dragster traveled compared to the furthest team. If two teams, make it to the end of the track and have the same deviation we will move to the shortest time from the dragster was released until it hits the back wall.
    - EX. If Team 1 travels 10 feet and Team 2 travels 5 feet, team 1 will receive 70 points and Team 2 will receive 35 points for this category.



- 20 points for 0 to 0.5 m away from the center line
- 15 points for 0.5 m to 1 m away from the center line
- 10 points for 1 m to 2 m away from the center line
- 0 points for any distance outside of 2 m

Presentation:

Team members must be prepared to present components of their project and explain the function of each, demonstrating an understanding of their device and the related engineering concepts. A budget breakdown is a required portion of the presentation. Presentations should be practiced beforehand and less than 5 minutes in length. Teams are encouraged to make a visual presentation such as a slideshow. Teams should be prepared to answer a few questions about design choices at the end of the presentation.

Presentation Rubric:

Total Presentation Points Available: 10

Topic Covered	Points and Criteria		
Budget	**4 Points-** Budget is present and described through each component used.	**2 Points**- Budget is present but not described well.	**0 Points-** No budget present.

Engineering Design Elements Used	**2 Points**- The team shows how they used engineering design to design the best dragster possible.	**1 Point**- Little explanation on how the team went about solving the problem given.	**0 Points-** There is no mention of the engineering design elements the team used.
Lessons Learned	**2 Points-** prototypes and previous models are shown for how they taught the team to create a better design.	**1 Point-** The lessons the team learned is mentioned but not explained	**0 Points-** There is no mention of the lessons learned through this project
Preparedness and presentation skills	**2 Points-** Presentation is well prepared and under 5 minutes	**1 Point-** Presentation was not practiced and poorly structured.	**0 Points-** Little to no preparation and poor presentation skills.

Final Score Addition:

Score (Max is 100 points) = $(L/L_{max})*70 + D + \text{Presentation Score}$

Submission:

Bring your final project to competition day, October 25th. Please submit your final presentation by October 24th, 11:59 PM via email to benbelanger@ku.edu. If you wish to present off your own device, be prepared to connect it to an HDMI cord.

Contact Information:

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