

Department of Chemical Engineering
University of Puerto Rico – Mayagüez Campus
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FUNDING PROPOSAL



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1. Table of Contents

| | | |
|-----|---|----|
| 1. | Table of Contents | 2 |
| 2. | The Chem-E-Car Competition | 3 |
| 3. | Team History & Awards | 4 |
| 4. | Meet Our Team | 5 |
| 5. | Team Structure | 8 |
| 6. | Project Description | 9 |
| 7. | Notable Chem-E-Cars & Technologies..... | 10 |
| 8. | Cokí's Chem-E-Car | 13 |
| 8.1 | Cokí T-RXN..... | 13 |
| 8.2 | Cokí's Next Vehicle | 14 |
| 9. | Expected Expenses | 15 |
| 10. | Sponsorship Categories | 18 |
| 11. | We Build People..... | 20 |
| 12. | Giving Back..... | 21 |
| 13. | Thank You..... | 22 |
| 14. | Contact Information | 23 |

2. The Chem-E-Car Competition

The Chem-E-Car Competition is an extracurricular activity hosted by the American Institute of Chemical Engineers (AIChE), one of the world's leading organizations for chemical engineers. In this competition, team members must design and construct a small-scale vehicle that is powered by a chemical reaction. Vehicles must be designed to travel a fixed distance between 15 and 30 meters while carrying a specific load between 0 and 500 milliliters of water. The challenge lies in the fact that students are told the specific distance and cargo an hour before starting the competition. The winner of the competition is determined by the vehicle that is closest to the finish line. Additionally, teams must prepare a poster describing the technologies and safety features that were integrated into the vehicle.

Safety Audit

As part of the competition, all teams are required to present their vehicle to a panel of judges and safety experts to show that they are in compliance with Chem-E-Car processes and safety regulations. The team must demonstrate that their vehicle is safe and that any hazards were mitigated during the manufacturing and calibration stages. In national conferences, a Safety Award sponsored by the Safety and Chemical Engineering Education (SAChE) is awarded to the team with the safest car.

Additional Awards

In addition to those already mentioned above, AIChE also grants the following awards:

- **Most Consistent Performance** –Awarded to the team with the best average score for the two runs that the vehicle makes.
- **Golden Tire Award** –Awarded to the team with the most creative vehicle design. A ballot cast by each team participating in the competition decides the winning entry.
- **Most Creative Drive System** –Recognition is awarded to the team that has designed and installed the most creative propulsion system.
- **Best Use of a Biological Reaction to Power a Car** –Awarded to the team who made the best use of a biological reaction.
- **Spirit of the Competition** –Awarded to the team who best exemplified sportsmanship during the competition.

3. Team History & Awards

The Cokí Racing Team was founded in 1999 by Edwin Colón, who graduated from the University of Puerto Rico at Mayagüez with a bachelor's Degree in Civil Engineering. Throughout the years, the Cokí Racing Team has proved its success by winning a great number of awards and has managed to make two perfect runs, a feat only accomplished by few in the history of the Chem-E-Car Competition. The following is a list of the most important awards the team has won since our participation in the World Congress of Chemical Engineering in August 2009:

| Event | Awards |
|--|---|
| 8th World Congress of Chemical Engineering Montreal, Canada - August 2009 | 1 st Place Performance Competition |
| 2009 AIChE National Conference Nashville, TN - November 2009 | 2 nd Place Performance Competition |
| 2010 AIChE Southern Regional Conference Raleigh, NC - April 2010 | 2 nd Place Poster Competition 3 rd Place Performance Competition Most Creative Design |
| 2011 AIChE Southern Regional Conference Atlanta, GA - April 2011 | 1 st Place Performance Competition 3 rd Place Poster Competition |
| 2011 AIChE National Conference Minneapolis, MN - November 2011 | 1 st Place Performance Competition 2 nd Place Poster Competition Most Creative Drive System |
| 2012 AIChE Southern Regional Conference Clemson, SC -April 2012 | 1 st Place Performance Competition 1 st Place Poster Competition |
| 2012 AIChE National Conference Pittsburgh, PA - October 2012 | 2 nd Place Performance Competition |
| 2013 AIChE National Conference San Francisco, CA - October 2013 | 2 nd Place Poster Competition |
| 2014 AIChE Southern Regional Conference San Juan, PR – March 2014 | 3 rd Place Performance Competition |
| 2014 AIChE National Conference Atlanta, Georgia – November 2014 | 1 st Place Poster Competition |
| 2015 AIChE Southern Regional Conference Tampa, FL – March 2015 | 1 st Place Poster Competition Most Creative Drive System |
| 2016 AIChE Southern Regional Conference Tuscaloosa, AL | Spirit of the Competition |
| 2017 AIChE Southern Regional Conference Knoxville, TN | 1 st Place Poster Competition Spirit of the Competition |
| 2017 AIChE National Conference Minneapolis, MN | 2 nd Place Poster Competition |
| 2018 AIChE Southern Regional Conference Baton Rouge, LA | 1 st Place Poster Competition |
| 2019 AIChE Southern Regional Conference Starkville, MS | 1 st Place Poster Competition 2 nd Place Performance Competition 3 rd Place Most Creative Design |

4. Meet Our Team

As has been in the past, for the academic year 2020 – 2021 the Cokí Racing Team will focus on how our structure provides opportunities for our members to develop in key areas by being challenged in out-of-the-ordinary situations. As our members skills develop, leaders arise in the team, creating prepared professionals for the future. By having the unique opportunity to work with members across different disciplines such as Chemical Engineering, Mechanical Engineering, Electrical Engineering, Computer Engineering, Computer Sciences, and Business Administration they can exchange information by assisting each other, acquiring knowledge that will help them cope as professional engineers. With this structure, the members will have a better perspective of the challenges their fellow teammates face in their respective areas. The following is a short description of the different roles within the team and some of their tasks.

- **Team Captain** –The team captain oversees the team, as well as guiding and encouraging members to work together to achieve a common goal: constructing an efficient and working vehicle whose traveling distance can be accurately predicted. Tasks and goals for the upcoming year include integrating an organized team structure, preparing funding proposals, developing new future team leaders, implement some reliability tools, and leading the team to win in the coming competitions.
- **Team Co – Captain** –The team co-captain works directly with the team captain and shares some of the captain's responsibilities. Tasks assigned to this role include recruiting new members as well as evaluation of current members and preparation of competition posters. The team co-captain works closely with the administrative branch.
- **Chief Administrator** –The chief administrator oversees the administrative branch including information, operations, and special projects management. The administrative branch maintains the team's finances, organizes fundraising activities and put travel plans together for competitions. The chief administrator is mainly responsible for ordering chemicals and vehicle parts and arranging travel plans. Tasks and goals for the upcoming year include the implementation of some Project Management tools such as Standard Works, Time and Cost Optimization Analysis, and Gantt Charts.
- **Administrative Assistant** – The administrative assistant works hand in hand with the chief administrator in any tasks that he/she so requires. To help maintain organization, the administrative assistant keeps our materials and manufacturing tools in check, resulting in a reduction of wasted time and profits. This will allow the team to work more efficiently with our budget.

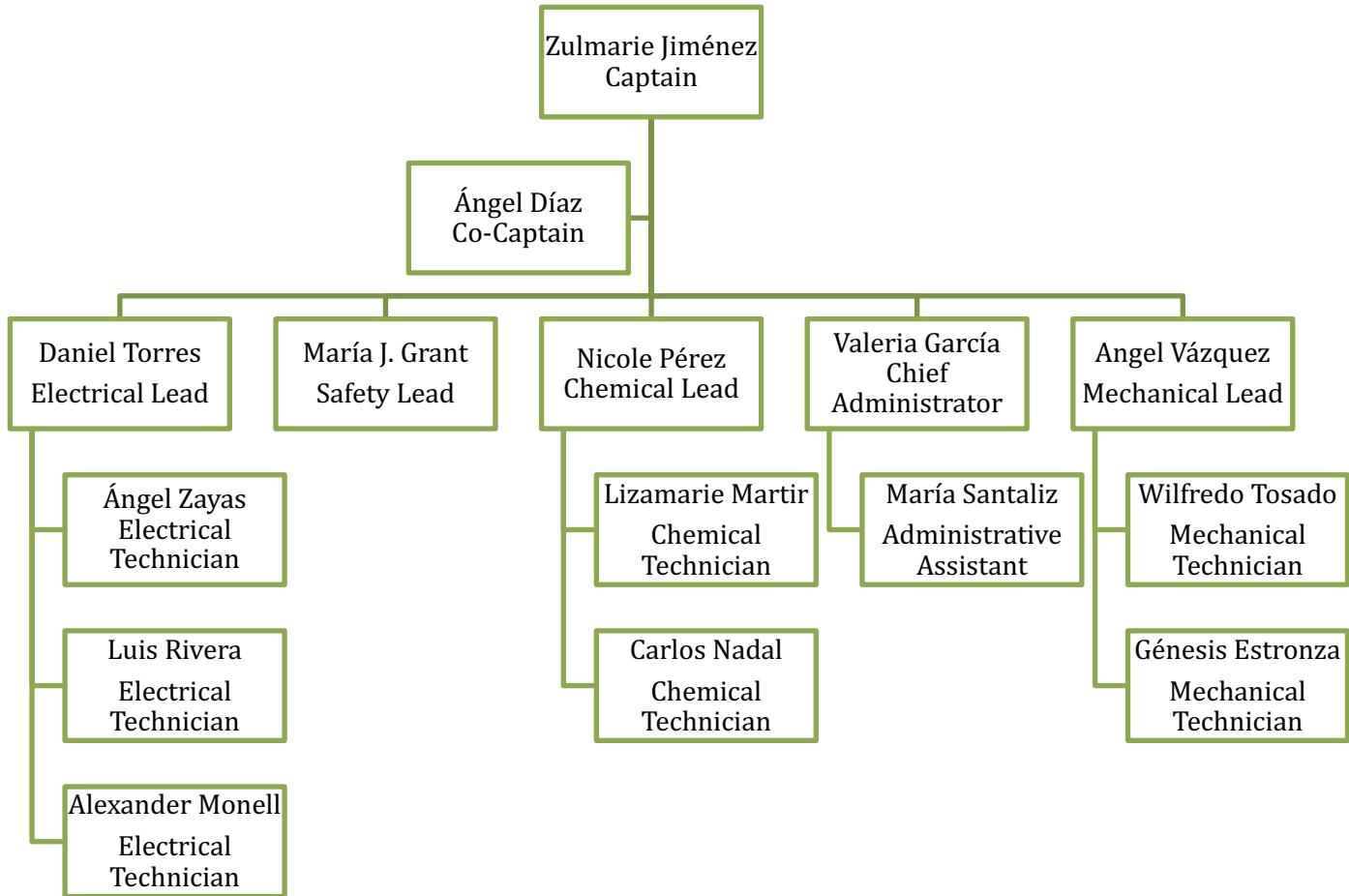
- **Safety Lead** – As one of the most important positions in our team, the safety lead is responsible for the writing of documents related to team and car safety. Examples include the Standard Operating Procedures and Management of Change forms. In the case of the latter document, the Safety Lead must approve the changes made to the car and how these will affect the team from a safety point-of-view. Once the changes have been approved, the Safety Lead must ensure that these are being followed to guarantee a safe working environment for the entire team.
- **Chemical Lead** – The chemical lead oversees the chemical division and makes sure all experiments and calibrations are conducted in a safe manner. This new academic year, the chemical lead will focus on identifying weak points in our power and stopping reaction systems and developing new testing methods to assess these faults.
- **Chemical Technicians** – The chemical technicians report to the chemical lead. They are responsible for conducting all experiments and calibration runs. They monitor system variables and record and analyze recovered data. Tasks and goals for this academic year are to design a new and reliable stopping mechanism while at the same time improving the current one to keep as a backup.
- **Mechanical Lead** – The mechanical lead oversees the mechanical division since they're responsible for the proper and safe manufacturing of the vehicle. Throughout the upcoming year, the mechanical lead will focus on developing a more reliable and efficient vehicle which will be the result of increasing the efficiency of the running, stopping, and power mechanism for future vehicles.
- **Mechanical Technicians** – The mechanical technicians report to the mechanical lead and are responsible for the manufacturing of the vehicle parts and designing engineering drawings of our current car as well as any future designs using different engineering software. Task and goals for this year are to design and develop a lightweight car and implementing new and previous technology such as turbines.
- **Electrical and Software Lead** – The electrical and software lead oversees the electrical and software technicians and their work. The person in this position is responsible for most of the development in coding and connections of electrical circuit known as the Arduino UNO or Raspberry Pi which performs various tasks in the assigned vehicle.
- **Electrical and Software Technicians** – The electrical and software technicians report to the electrical and software lead. It is not out of the ordinary for electrical technicians to work alongside the mechanical technicians in the manufacturing of the vehicle. However,

along with software technicians, they are in charge of developing a control system for monitoring key variables such as temperature, pressure and velocity. The electrical technicians will be working with the optimization of the electrical circuit for any vehicles as well minimizing the electrical energy consumption.



2019 Cokí Racing Team Members

5. Team Structure



6. Project Description

The Cokí Racing Team has successfully represented the University of Puerto Rico at many Chem-E-Car Competitions for almost two decades. We believe the key to our success lies in teamwork, innovation, diversity and a strong team structure. The following is a short description of the various stages our team goes through to design and manufacture high-performing vehicles.

- **Research** – Our team is constantly searching for new technologies that can be implemented in the design of a new vehicle or that can be used to improve the design of an already existing one. The Cokí Racing Team keeps its competitive edge by using technologies never heard of in Chem-E-Car Competitions.
- **Development** – Once we have selected a new technology, we proceed to the development phase. Before manufacturing our vehicle, we create a visual model of the vehicle and ensure that the design is safe and complies with Chem-E-Car rules. After completing and verifying the model, we begin the manufacturing process. This is typically one of our most critical and time-consuming stages.
- **Calibration** – After the vehicle has been manufactured and tested, the team is ready to begin the calibration process. This process takes place approximately two months prior to the competition and is the most challenging stage of our project.
- **Competition** – The Cokí Racing Team participates in the Chem-E-Car Competitions every year. Time after time, our team has proven to be one of the competition’s toughest participants, always managing to bring home awards and accolades. We represent Puerto Rico and our school with great pride and success as we face some of the best universities in the United States.
- **Recruiting** – We begin our recruiting process at the beginning of every semester. We interview engineering students and select only a handful to join the team as a “try-out” or “intern” for a period of one semester. During this time, we evaluate their technical skills, creativity, enthusiasm and organizational fit. At the end of their “try-out” period, the team decides who will be extended an offer to join the team as an official member.

7. Notable Chem-E-Cars & Technologies

Throughout our history, the Cokí Racing Team has used many different technologies when designing and manufacturing vehicles. The following are some of our most efficient and successful technologies.

| Cokí Turbo & Cokí TT | |
|---|--|
|     | <p>Pressurized gas was generated by a hydrogen peroxide decomposition reaction, using potassium iodide as a catalyst.</p> <p>Cokí Turbo: The oxygen generated from the reaction flowed through two tanks and a filtering system before expanding in a turbine, which in turn moved the car.</p> <p>Cokí TT: The produced current was stored in capacitors connected to the generator. These were connected to an electric motor, which initiated movement.</p> |

| Cokí Stroj | |
|--|---|
| Oxygen was produced from a hydrogen peroxide decomposition reaction. The produced oxygen flowed from the reactor to a 4 inline piston Lego® engine controlled by a normally closed solenoid valve. |  |

Cokí GT-E



A temperature differential is generated by the exothermic decomposition of hydrogen peroxide and the cooling properties of ethylene glycol. Thermoelectric generators (TEGs), convert this temperature gradient into electrical energy. The energy is supplied to an electric motor, which moves the vehicle.

Cokí MV-1

Using pressurized oxygen rich-air generated from a hydrogen peroxide decomposition reaction, the MV-1 moved by using a single piston steam engine. A similar decomposition reaction was used for the stopping mechanism in which the pressure generated moves a column of water until it reaches a photoresistor which triggers the circuit to close a solenoid valve, stopping all pressure flow.

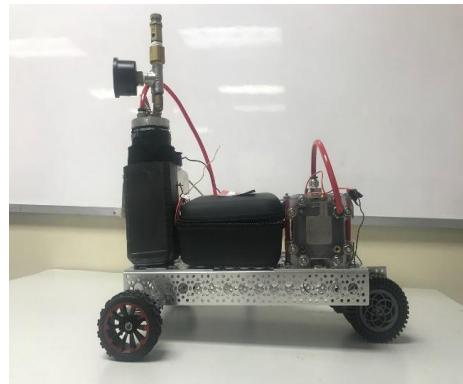
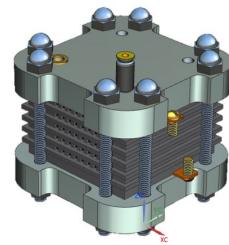
This vehicle was updated year-by-year, namely the stopping mechanism and the transmission components.



Cokí Evo

The Cokí Evo is powered by a flameless heater reaction, which is an oxidation-reduction reaction of magnesium and water. A tank is connected to a five-cell fuel cell stack in which the hydrogen outputted from the flameless heater reacts with the ambient oxygen to produce voltage and current. A toggle switch is activated to close the circuit, allowing the current to reach the electric motor fixed between the front wheels, propelling the car forward.

The Cokí Evo's brake system comprises a decomposition reaction of 3% w/w hydrogen peroxide attached to a pressure sensor. When the specified pressure, 5 psig is attained, the current flow to the electric motor is interrupted and the vehicle comes to a full stop.

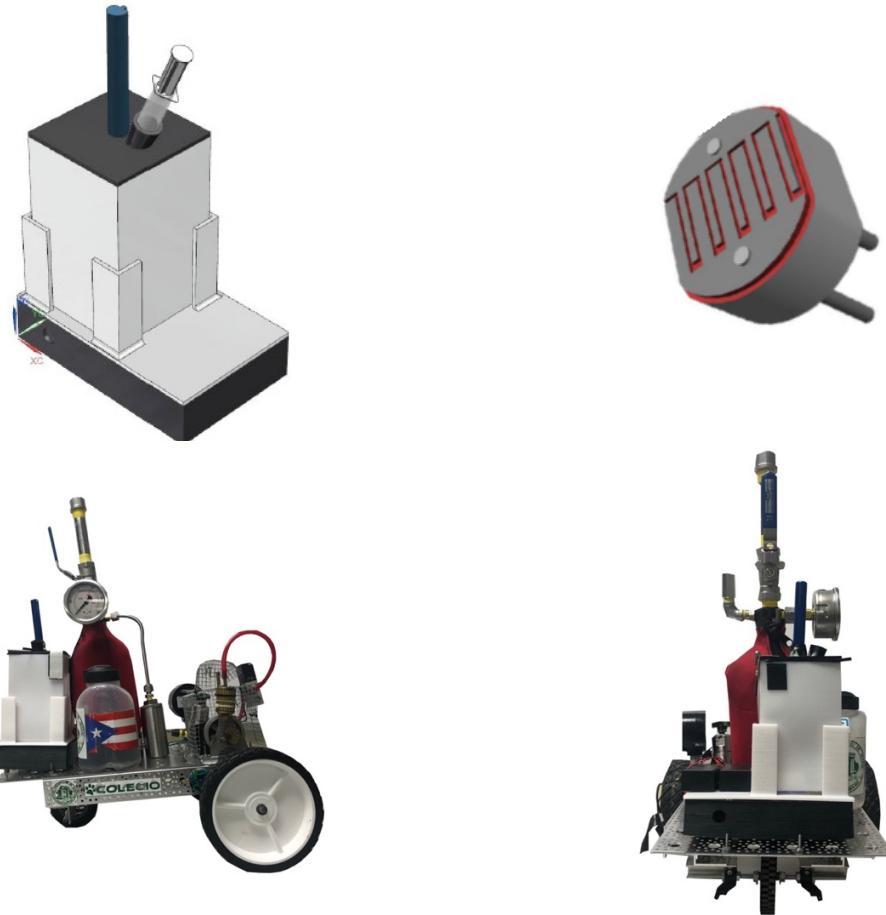
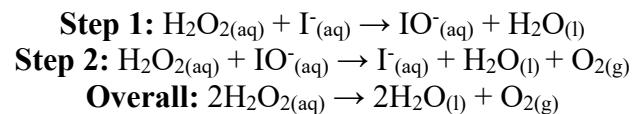


8. Cokí's Chem-E-Car

8.1 Cokí T-RXN

The Cokí T-RXN is powered by the pressure generated from the decomposition of hydrogen peroxide (30% w/w) with a potassium iodide catalyst. The reaction takes place in a carbon fiber reinforced aluminum tank. The reaction products, oxygen and water, pass through a coalescing filter where the water is removed from the system. The resulting oxygen-rich air flows through the system, passing a pressure regulator until reaching a normally-closed solenoid valve. A toggle switch is activated to open the valve, allowing the oxygen-rich air to reach the oscillating steam engine, propelling the car forward.

Running Mechanism Reaction:



The main component of the braking system uses a reaction of hydrochloric acid with sodium thiosulfate. The solid sulfur suspended in the product solution blocks the light transmitted to a photoresistor and triggers the braking mechanism by closing the solenoid valve. The concentration of the sodium thiosulfate solution is varied to control the distance traveled by the vehicle.

8.2 Cokí's Next Vehicle

For this year, the Cokí Racing Team decided to revisit our history and use the Cokí Turbo Chem-E-Car as a baseline for our new Chem-E-Car. As part of the learning and work plan for this year, the Mechanical Division is going to focus in the design, analysis and manufacturing of turbines and design and construct a vehicle with energy efficiency and weight as primary concerns. The Electrical and Chemical Divisions are going to do thorough research in order to create a precise braking system that will allow us to get better results and reduce the amount of calibration runs, therefore, reducing the time and money spent in our pre-competition process.



Cokí T-RXN in AIChE's 2019 Southern Regional Conference

9. Expected Expenses

There are a number of expenses our team must cover in order to construct a successful vehicle and be able to compete. Most of our expenses are associated with the purchasing of chemicals, manufacturing of vehicle parts, competition registration fees, and traveling costs. The following is a breakdown of the expected expenses for the academic year 2020– 2021:

Manufacturing Expenses

| Description | Quantity | Unit Price | Cost |
|---------------------------|----------|--------------|-------------------|
| Pressure Relief Valve | 1 | \$87.00 | \$87.00 |
| Ball Valve | 1 | \$82.00 | \$82.00 |
| Lexan Polycarbonate Sheet | 4 | \$14.00 | \$56.00 |
| PLA 3D Printer Filament | 3 | \$40.00 | \$120.00 |
| Precision Ball Bearings | 20 | \$1.25 | \$25.00 |
| Dremel Kit | 1 | \$120.00 | \$120.00 |
| 3D Printer | 1 | \$700.00 | \$700.00 |
| Mechanics Tool Set | 1 | \$90.00 | \$90.00 |
| | | Total | \$1,280.00 |

Chemical Expenses

Based on 80 Calibration Runs Per Competition

| Description | Quantity | Unit Price | Cost |
|-----------------------------------|----------|--------------|-------------------|
| Hydrogen Peroxide 30% (500 mL) | 7 | \$77.00 | \$539.00 |
| Potassium Iodide (250 g) | 4 | \$70.00 | \$280.00 |
| Hydrochloric Acid 37% (500 mL) | 1 | \$75.00 | \$75.00 |
| Sodium Thiosulfate (250 g) | 2 | \$55.00 | \$110.00 |
| Acetone (16 oz) | 10 | \$8.00 | \$80.00 |
| Storage Bottle (250 mL) | 1 | \$55.00 | \$55.00 |
| Storage Bottle (500 mL) | 1 | \$65.00 | \$65.00 |
| Glass Vials 20mL (72/pack) | 1 | \$75.00 | \$75.00 |
| Paper Towel, Gloves | 4 | \$15.00 | \$60.00 |
| High Precision Digital Scale | 1 | \$50.00 | \$50.00 |
| Analog Vortex Mixer | 1 | \$409.00 | \$409.00 |
| Single Channel Pipette (0.5-5 mL) | 1 | \$322.00 | \$322.00 |
| | | Total | \$2,120.00 |

Electrical Expenses

| Description | Quantity | Unit Price | Cost |
|-----------------|----------|--------------|-----------------|
| Solder Wire | 1 | \$6.00 | \$6.00 |
| Resistors Kit | 1 | \$10.00 | \$10.00 |
| Capacitors Kit | 1 | \$11.00 | \$11.00 |
| Transistors Kit | 1 | \$14.00 | \$14.00 |
| Diodes Kits | 1 | \$14.00 | \$14.00 |
| Toggle Switch | 1 | \$11.00 | \$11.00 |
| Arduino Uno | 1 | \$20.00 | \$20.00 |
| Rosin Paste | 1 | \$8.00 | \$8.00 |
| Battery Holder | 2 | \$3.00 | \$6.00 |
| | | Total | \$100.00 |

Registration and Travel Expenses

2020 National Conference

| Description | Quantity | Unit Price | Cost |
|--------------------------|------------------|----------------------|-------------------|
| Team Member Registration | 6 | \$130.00 | \$780.00 |
| Chem-E-Car Registration | 1 | \$200.00 | \$200.00 |
| Flight Tickets | 6 | \$400.00 | \$2,400.00 |
| Hotel Fare | 2 rooms/3 nights | \$159.00 p/ night | \$954.00 |
| Rental Car | 1 car/4 days | \$150.00 p/ day | \$600.00 |
| | | Total | \$4,934.00 |

2021 Southern Regional Conference

| Description | Quantity | Unit Price | Cost |
|--------------------------|------------------|-------------------|-------------------|
| Team Member Registration | 6 | \$85.00 | \$510.00 |
| Chem-E-Car Registration | 1 | \$100.00 | \$100.00 |
| Flight Tickets | 6 | \$550.00 | \$3,300.00 |
| Hotel Fare | 2 rooms/3 nights | \$120.00 p/ night | \$720.00 |
| Rental Car | 1 cars/4 days | \$150.00 p/ day | \$600.00 |
| | | Total | \$5,230.00 |

The expenses summarized above reflect our 2020 – 2021 work agenda. Taking into account chemical, manufacturing, electrical, registration and traveling costs, the total expected expenses for the upcoming year add up to **\$13,664.00**.

10. Sponsorship Categories

It is our desire that your company becomes an active part of our team. By investing in this team your company will benefit from media exposure, use of the car for your own publicity (subject to sponsorship level), and will receive acknowledgment for your collaboration. Your support means a great deal to the students that are brave enough to take on this challenge. The following is a detailed description of the different sponsorship categories and benefits.

Platinum

Support Value – \$5,000+

Platinum Level Benefits:

- Prime location of company logo in competition poster, team uniform, and Chem-E-Car.
- Provided option of having the company logo in both team shirt and cap.
- Company logo and name on promotional displays, newsletters and websites.
- Planning and organizing of recruiting events and workshops during any time of the school year; upon request. The team will take responsibility for booking location, ordering any snacks or food and successfully organizing and promoting an event.
- Access to team's Résumé Book.

Gold

Support Value – \$3,000+

Gold Level Benefits:

- Good visibility of company logo in competition poster, team uniform, and Chem-E-Car.
- Company logo in team shirt only.
- Company logo and name on displays, newsletters, and websites.
- Planning and organizing of small recruiting events during Job Fairs; upon request. These include informational booths and workshops.
- Access to team's Résumé Book.

Silver

Support Value – \$1,000+

Silver Level Benefits:

- Company logo in competition poster, team uniform, and Chem-E-Car. Location and visibility subject to available space.
- Company logo in team shirt only.
- Company logo and name on promotional displays, newsletters and websites.
- Access to team's Résumé Book.

Bronze

Support Value – \$500+

Bronze Level Benefits:

- Company logo in competition poster and Chem-E-Car. Location and visibility subject to available space.
- Company logo and name on promotional displays, newsletters and websites.
- Access to team's Résumé Book.

11. We Build People

The Cokí Racing Team does not only build cars; it also builds people. Our team is not simply structured to build winning vehicles on the competition course, but also to challenge our members' skills, often forcing them to step outside their comfort zone. We do this by establishing a flexible and continuously changing team structure, which gives members the opportunity to experience different roles within the team and expand their skill set to become well-rounded professionals.

In the upcoming year, we will continue to develop the team's overall knowledge and capability by providing our members with workshops and other activities that will challenge their strengths and improve their weaknesses. Among these will be financial workshops for the administrative branch that will demonstrate how to properly manage business accounts and financial budgets, design workshops that will teach members how to construct more complex electrical systems, and communication workshops that will teach all members the art of effective communication. We are confident that introducing these type of activities to our yearly schedule will prove to be beneficiary for the entire team.



2019 AIChE National Conference

12. Giving Back

The Cokí Racing Team is also very strongly committed to its community. We promote our Chemical Engineering Department, the University of Puerto Rico at Mayagüez, and our sponsors in high school seminars and open houses around the island. Although these events vary from year to year, we typically take part in supporting activities from other organizations such as SHPE Career Development Day, NSPE Mentoring Program, SWE Future Female Engineers, High School Open Houses, NanoDays Interactive and UPR Open Houses. We take pride in knowing that we can introduce the world of science and engineering to captivated audiences all over the island.



2020 UPRM Services and Admissions Fair

13. Thank You

We appreciate your interest in the Cokí Racing Team, thank you for taking us into consideration for sponsorship for the 2020 – 2021 academic year. We hope you will become an active part of our family in the near future. It is because of the support of companies that, year by year, the Cokí Racing Team helps shape students to professionals and transform effort into awards.



2019 Southern Regional Conference
Starkville, MS
1st Place Poster Competition
2nd Place Performance Competition
3rd Place Most Creative Design

14. Contact Information

If you have any questions regarding the team, the competition or anything included in this proposal, we encourage you to contact any of the team members listed below based on your needs. We will be happy to work with you.

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