THE
SOLAR FLARE

December 2014

Looking Back, Looking Forward

Clayton Harper

As of this writing, the Principia Solar Car team finds itself between two major competitions—the American Solar Challenge, which took place this July, and the Abu Dhabi Solar Challenge, which will premier this January. The team is ecstatic to be presented with so many larger-than-life opportunities, and we work hard to meet each opportunity by exemplifying the goals outlined in our mission statement: glorifying God and doing our best.

As a new addition to the team, I can personally attest to the commitment of each individual to these ideals. The challenges that the team faced on the race this summer were, in a word, extraordinary, and the team met these challenges with extraordinary calm, extraordinary dedication, and extraordinary perseverance.

Never a team to idle, the students have been hard at work perfecting the nearly-complete Ra 9 after her debut this summer. In addition to the installation of front and back fairing windows, various mechanical and electrical tweaks, and a little maintenance & repair, the team has constructed a shipping crate, packed countless boxes of race equipment, and managed complex logistics in preparation for the upcoming race. Students have also participated in many hours of road testing and driver training to learn race roles and responsibilities. As always, it is an exciting time for Principia Solar Car.

In this newsletter, you will find personal reflections on students' experiences during the American Solar Challenge this summer, as well as their experiences as new team members. We have also included an overview of the Abu Dhabi Solar Challenge and a summary of the process that went into constructing our shipping crate. We hope you enjoy what we have to share, and we thank you for all your support.

My Summer 'Vacation'

Steve Shedd

Despite a dedicated group of students working 12-18 hour days all summer on the project, when leaving for Austin, Texas, Ra 9 was still unfinished. Continuing to work on the car upon arrival, the team busily prepared for the upcoming week. The schedule included three days of scrutineering and a three-day track race to qualify for the cross-country race. At the end of the second day of scrutineering, Ra 9 had not moved one inch under its own power. By contrast, many of our competitors had driven their cars in multiple races, with one team having driven their solar car over 9,000 miles prior to arriving in Austin. At the end of the third day of scrutineering, however, our car had not passed the wet braking test. Our students spent the entire night and following morning moving our 85 lb. battery pack from behind the driver to in front of the front wheels for better weight distribution for the brake test. Even with this new configuration, it took several hours for two drivers to pass the brake test. We had hoped to approve four drivers for the race, but only passed two. The brake test proved quite difficult for many schools, and several teams (including MIT) didn't pass, and consequently could not even participate in the cross-country race.

On Friday, the second day of the track race, Ra 9 entered the track and performed very well. Racing from 9 AM to 5 PM, Ra 9 completed the most laps of any team that day, 53, on the 20-turn, 3.4 mile long Formula One racetrack. Fairing windows had yet to be installed on the car, and we knew that completing this task would greatly improve the vehicle's aerodynamics. Our plan for Saturday was to complete the required number of laps to qualify for the road race and then install the fairing windows. At that point, we would have to prove to race officials that the car was still safe by repeating the Figure-8 test and executing several laps with the windows installed.

However, our plans changed when we arrived at the track at 6:30 AM on Saturday to find that our open car and all of our tools, equipment, and electronics had been covered with fourteen inches of water from the sprinkler system overhead. The team adjacent to us, Illinois State, had left their batteries charging all night and their battery pack caught on fire, melted their car, and set off the sprinklers. There were two other teams in the bay, Minnesota and Western Michigan, but their cars were closed and covered, which allowed them to avoid internal damage.

Immediately, I called my wife and told her we had our work cut out for us and that we might not make the cross-country race due to the car's condition. The students, however, went right to work without complaining and attacked the Herculean task. We had to clear everything out of the garage and move to a different pit. The chromoly steel frame had extensive rust because we did not have time to paint the frame before departing for Austin. Students had to remove the frame from the body and remove every nut, bolt, and piece of wire from the frame. The students then scrubbed the frame with steel wool and WD-40. We dumped the remaining 5 inches of standing water out of the lower body and left it upside down to drip for several hours. Our electrical tools were ruined (charger, meters, laptops, power tools, etc.). The small components from the car and the steering wheel were packed in rice in an attempt to dry them out. Our laptop computers were emptied of water and taken apart to dry, but never did work again.

The race officials felt bad for us, but had written us off believing our car could not possibly run again. Amazingly, after nine hours of hard work, our car took the track and finished enough laps to qualify for the race. It's wonderful to see that our students don't merely think and believe that they have no limits, but understand and demonstrate that they have no limits.

Despite having accomplished this monumental feat, the time taken to repair the car left no time to install fairing windows, meaning that Ra 9 would have to race without them, causing a severe increase in aerodynamic drag. Of the 21 teams that showed up in Austin, only 10 qualified for the cross-country race, with Principia starting in 9th place. The majority of the teams had cars with 3-wheel designs, but Ra 9 uses four wheels in order to additionally participate in the World Solar Challenge in Australia. The American race allows thin tires with no tread and little rolling resistance inflated to 110 psi, while the Australian regulations require much wider DOT approved treaded tires that can only be inflated to a much lower pressure. This meant that Ra 9 had an additional wheel causing both more rolling resistance and without the faring windows much more aerodynamic drag than the other competitors. Principia finished the 1,700 mile race from Austin to Minneapolis in 5th place and was the only four-wheeled car to complete the race using only solar power. This is a demonstration that I will remember for many years to come.

Solar Car Race Experience

Michael Rohrer

As a new team member and participating in my first race, I was introduced to many new topics which ranged from suspension design to the tests the car undergoes during scrutineering. The amount of experience and information I gained about solar cars was tremendous! During the summer, I learned how the design and build process work, how the car is tested, and what it means to race a solar car.

For me, the design and build process is the most enjoyable part of my experience on the team. I really enjoyed seeing components that my teammates and I designed in our CAD package, NX 8.5, come to life. It is rewarding when you see the real-world components all fit and form a working car. However, sometimes things don't fit the way they were expected to and have to be modified or remade. Once all the components are made, the assembly process begins, and the car is assembled and tested as different components are added.

After the car is completed, it must complete a series of tests to assess the car's capabilities in situations it may see on the road. This process is called scrutineering, and includes braking tests, figure eight maneuvers, U-turns, slalom runs, and other static tests. These trials gave me an idea of the situations the car might see on the road.

During this process, I learned that it is not uncommon to encounter challenges during scrutineering. One challenge that we faced was a horn that was too quiet due to its placement inside the fairing. In order to solve this issue, we had to move the horn so that it was facing out of the bottom of the fairing. Even though this issue was minor, it is an example of a challenge I saw the team address in a calm and productive manner.

Lastly, I learned what it means to race a solar car. This summer we competed in the Formula Sun Grand Prix and the American Solar Challenge. The Formula Sun Grand Prix was the qualifier for the American Solar Challenge. I gained an appreciation for the speed at which things are accomplished and the importance of every decision that is made on the team. Communication and planning are crucial when we are on the road and the car stops working. When something went wrong, we had to fix the issue as quickly as possible in order to continue the race against time and other teams.

The Principia Solar Car Team has presented me with many opportunities and continues to teach me valuable lessons. Not only is solar car a fun experience, but it has taught me how to address challenges and solve them efficiently. The race experience for me is invaluable, and I have already applied the lessons I learned during the race to other aspects of my life.

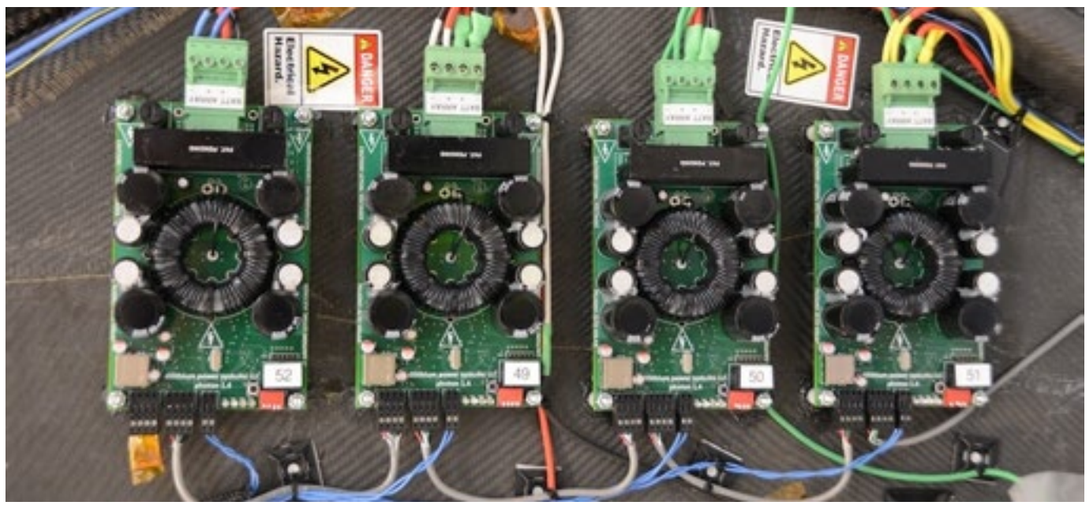
Working as a team

Jackson Walker

This summer I had the pleasure and privilege to participate in the American Solar Challenge in Austin, Texas. I was a member of our team's electrical squad, which dealt with the electrical systems and motor. Working as a part of our team was an experience which I will never forget, as it taught me the value of each individual within a team. Teamwork was essential in order to accomplish tasks and get vital parts of the car completed in a timely manner. Coming into a competitive solar car race, I expected our team to work together well and provide synergy and support; what I didn't expect was the synergy and support of all the teams at the event.

The surprise for me during the American Solar Challenge and the track race at the Circuit of the Americas was the support of the 'opposing' teams. I went into the competition expecting a hostile, competitive environment, and was quite surprised to find a highly-skilled and loving group of undergrads who were more than willing to share information, time, skills, or materials. Our team and others shared parts that were needed and shared hints & tips that we had found during our struggles. Seeing teams come together to help the Principia Solar Car Team after our car was doused by emergency sprinklers was a moment I will never forget. I had seen how the teams worked together, but this act of selflessness and camaraderie was astonishing. It was then that I realized that the goal of this competition was not to beat everyone else, but to come together and get as many of these prototype solar vehicles running as possible.

My experience this summer wasn't based in winning or losing, but around the sportsmanship and compassion expressed in this event. I have never participated in an event that has encouraged my own growth like this one did. I will forever be grateful for the wonderful experience of camaraderie that the American Solar Challenge has given me.



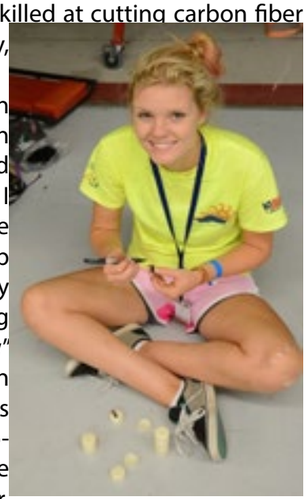
Adventures of Solar Car

Tamara Thomas

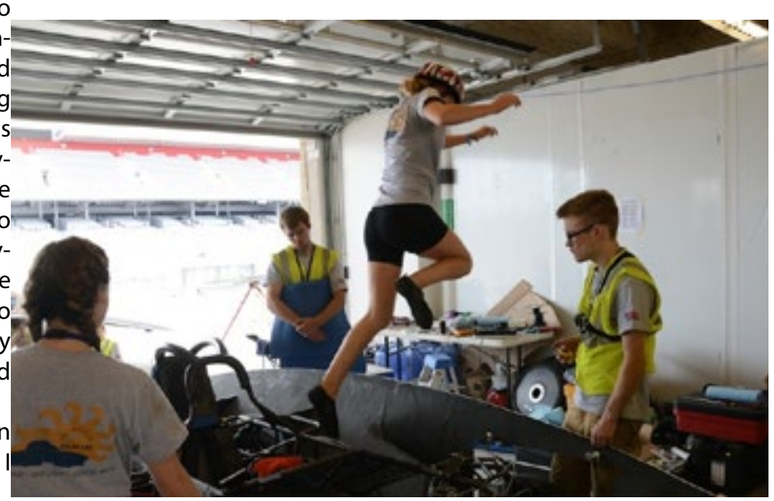
Hey there! My name is Tamara Thomas and I am currently a senior on the team studying Mass Communications. The 2014 American Solar Challenge this summer was my second race and it was quite the experience! This was my first road race, so it was definitely a different experience than the Formula Sun Grand Prix (FSGP) I had participated in the previous summer. In the 2013 FSGP there was only a track race and we were done within a week. With the American Solar Challenge, better known to the team as ASC, we spent over two weeks with the event, starting on the track and ending over 1700 miles from where we began.

As you have probably heard by now, we had some incredible feats to overcome, which was nothing like we had experienced the summer before. During the race this summer I was originally going to be a driver, but in the time crunch we faced, we were only able to qualify two of our four drivers. Although it would have been a great experience to drive in the race, I was happy to be a part of the team and support however I could!

My other roles on this race were a bit varied. I helped with whatever was needed, which ended up being a lot of body work on the car. This meant making a lot of carbon fiber pieces for structural support, switch boards, paneling, and all sorts of other uses. This also meant epoxying these pieces together and to the car. I got pretty skilled at cutting carbon fiber and working with epoxy, if I do say so myself!



My other main role was safety. I began the road race as "lead safety," which meant I rode in the lead vehicle and was the first to hop out in the case of any road stops. I would bring cones and a "stop/slow" sign with me to warn traffic that there was something worth protecting on the side of the road. A couple days later, I moved back to the chase vehicle and became "chase safety."



While I was chase safety, I had to be ready to jump out of in an instant if we pulled over for a driver change or maintenance on the car. This made for some interesting moments, as sometimes during long stretches of continuous travel I would doze off, as many of us did. At one point during the race after a very long night of maintenance on the car, I was sleeping quite comfortably, using my bench buddy Kenneth as a pillow, when all the sudden I heard "Safety out!" over the radio. Still waking and slightly unaware of what was going on, I jumped up in a slight panic, grabbed my cones and sign, and went to open the door.

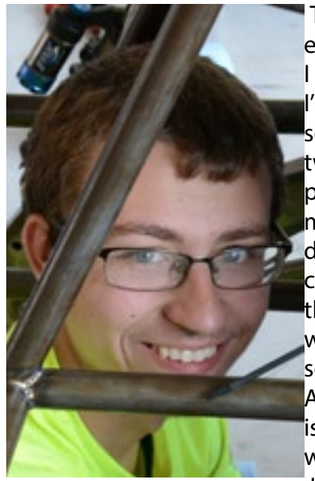
Right then, whatever issue we were having fixed itself and the stop was called off. At that point, I was about to jump out of the van, adrenalin pumping, and very confused. Everyone laughed at how frantically I had prepared myself for the exit and told me to go back to sleep.

I think my favorite part of the race this summer was all of the funny moments like this one. I can confidently say that everyone had at least one. We had an incredible team dynamic this summer and even when we were all laughing at something, there was this indescribable sense of support and love from every person. I am so grateful for the opportunity to be a part of such an incredible team and amazing experience, even after facing challenges some might have deemed impossible. It really shows how far our team goals—glorifying God and always doing our best—can take us.

Of course, none of this would have been possible without our incredible supporters. I think I speak on behalf of everyone on the team when I say we are unbelievably grateful for everything you have done to help us succeed. From prayers, to donations, to cheering us on wherever you may be, we cannot thank you enough.

My first year

Gage Edgar



This first race experience was deeper than I could have imagined! I've wanted to go on a solar car race since I was twelve, so this race experience was the fulfillment of my childhood dreams. When I was a child, I imagined that the purpose of solar car would be mostly on the solar cells themselves. As it turns out, solar car is almost the opposite of what I imagined it to be.

I knew that being a part of the Principia Solar Car Team would be a lot of work, but I didn't know that it would be as much work as it was. This underestimation of time/effort was a theme during the summer. It was said that the team rule for estimating the time required for a task was to "multiply by 3 and add 30 minutes".

Before joining the solar car team, I couldn't imagine how much manual labor was involved. From machining to layups to cutting carbon fiber, my skills with manual labor have increased tremendously. Seeing others who can do things I can't can be discouraging, but the process of practice and improvement has worked for me quite well.

Being involved with the team during a build cycle was rewarding because I got to experience everything involved with the car. I improved my manual labor skills and I was involved with building the plugs, the molds, and the body. I was able to learn a lot more about NX, our design software, and I built friendships that will last a lifetime.

My roles during the race were rear spotter and car body-cleaner. As the rear spotter in the lead vehicle, I monitored the solar car continuously and told the driver if there was a car between our vehicle and the solar car. At the end of the day, I waxed the car body with Tamara, and during every stop I cleaned the windshields. Throughout my time on solar car, I've been nicknamed "the cleaning head" because I've done a lot of the cleaning for the team. I do this because I am not a natural mechanic nor a member of electrical team, so I have felt that cleaning is the best way I can contribute to the team. I am glad that my hard work offers something that is useful and important to our success.

Solar car was the biggest learning experience of my life, and I value this experience more than a summer job's worth of pay. After several sleepless nights and eight weeks of non-stop work, I felt the need for a three-week break. However, if I could do it all again, I would choose to do so in a heartbeat.

Not even the smell of smoke

Ariana Dale

As the metaphysical head for this summer's American Solar Challenge, there were moments when I would stand for a few moments and feel almost overwhelmed by the task at hand. It seemed like it was my responsibility to return the situation to a sense of harmony and normalcy. After a phone call to our team practitioner, I was quickly reminded that it was God's wisdom, strength and harmony guiding us along our journey. Our car, Ra 9, is a complete idea of God's, and He would bring His idea to fruition.

It was 6:15 am on the last day of qualification when the Principia Solar Car team was alerted that the neighboring car in our bay had caught fire and set off the emergency sprinklers. Ra 9 had been filled with 8 inches of water, our solar array was covered in carbon ash, our electrical components were drenched, and our molybdenum chrome steel frame had become a rusty cage.

To many teams this might have been the kind of disaster to warrant packing bags and heading home, but for the Principia Solar Car team there was only one thing to do, and that was to charge forward with the strength we trusted God would provide. We had worked so hard for so long, and there was no giving up now.

The day before the flood we had come a few laps short of qualifying, and this followed an all-night effort to redistribute the interior weight of the car so that we could pass the brake test. A week before Ra9 wasn't running on its own power. And a week before that no one had sat in the car. There was no denying that the Principia Solar Car team had the work ethic, determination, and trust in God's unfolding harmony. We set to work with a strong mindset, and after the flood, we were able to take apart the car, clean it, put it back together, and get on the track all in just over seven hours.

With each situation the team overcame, there were two things I had to recognize right away. The first was that it was out of my hands; we could rely solely on God for His harmonious solution. The second was that in a solar car challenge there isn't a sense of "normalcy." Each day presented its own challenges and adventures. But that's the best part about the Principia Solar Car team: we can always count on success and triumph.

Abu Dhabi Solar Challenge (ADSC)

Clayton Harper

This January, the Principia Solar Car Team will participate in the Abu Dhabi Solar Challenge, a roughly 1200km road competition taking place in the city itself and within the emirate proper. Over 20 teams, including programs run by students and professionals, will compete in the event.

The route itself will be completed over four days and will feature a variety of road and driving conditions, presenting a unique challenge for the teams to overcome. The map above illustrates the route the teams will follow.

On Day 1 (purple), the teams will begin in Abu Dhabi and follow a narrow loop out to the Mirfa Hotel and back, ending in Masdar City. On Day 2 (olive), the teams will travel from Masdar City to Al Ain University of Science and Technology and back in another full day loop. On Day 3 (green), the teams will begin the first section of a two day stage, beginning in Masdar City and ending at the Shams I solar power station. On Day 4 (red), the teams will complete the loop into the heart of Abu Dhabi, crossing the finish at the FGB Arena.

The Principia Solar Car Team is delighted to bring Ra 9 to the inaugural Abu Dhabi Solar Challenge, and we look forward to sharing our experiences with you once January rolls around.

Packing the Solar Car

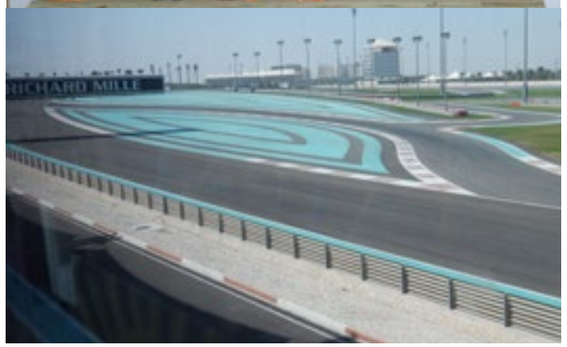
Andrew Rohrer

During the winter of 2015, the Principia Solar Car team will be heading to Abu Dhabi to compete in the Abu Dhabi Solar Challenge. Abu Dhabi is the capital of the United Arab Emirates, which borders south eastern Saudi Arabia. Throughout the semester, the solar car team has been preparing for the race, working on projects such as tweaking the fairings (the aerodynamic wheel covers) and building and packing the shipping crate.

Building and packing the shipping crate was a big group effort. The team has about 30 students that help get tasks done every week during scheduled work time, and it proved helpful to have so many team members for building the crate. Building the crate required many people to level, measure, and cut different shapes and sizes of boards that would then be assembled according to a master plan. Starting with the floor of the container, the team was able to spend three hours and finish all the framework of the car. After that, all the plywood was added to create the walls and shelves. Multiple doors were cut out of the side of the car to allow easy access to the somewhat unique arrangement of shelves inside the crate.

The next objective was to confirm that the race team signed up to compete in Abu Dhabi could lift Ra 9 into the crate by themselves. After 2-3 minutes of maneuvering, planning, and effort the car was settled into the crate, ready for shipping. The next task was to make sure that all the correct spare parts, tools, and other necessary items were packed into their assigned boxes. There were many lists of items that needed to be packed for the race abroad.

Once again, having many hands made the work easier. The group was divided into a few different teams that were in charge of gathering equipment for certain boxes. After many hours of packing, the boxes were then brought to the crate to pack. Finally, the crate was packed and shipped to Illinois State University to be packed into a bigger shipping container, shared with the Illinois State team who is also competing in Abu Dhabi. After a semester of hard work, Ra 9 is finally on its roughly month-long journey across the Atlantic to meet the team for the challenge in Abu Dhabi.



A moment of thanks

Clayton Harper

The Princpia Solar Car team's participation in the American Solar Challenge this summer was supported by the extroadinary generosity and thoughtfulness of a number of individuals. We feel deeply indebted to all those who have contributed to the sucess of this program, and we would like to take a moment to name a few of those individuals who helped make our efforts this summer possible.

Janna Bridges-Walker

Warren Clinton

Rita Davis

Diane Donaldson

Jennifer and Bill Dale

Linda Farquhar

Karen and Jerry Grimmer

Frieda Hadley

Liza Hagerman

Bruce and Dede Holser

John and Karen Hooper

Jean Horner

Malcom and Carol McFall

Dr. John and Grace Obetz

Alan Rice

Janice Ritter

Becky and Susie Ritter

Rob and Jill Rohrer

Chris Snow

Steve and Debbie Warren

Ira Yates

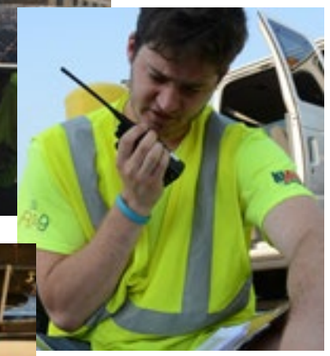
Alain Chuzel and Linda Bozarth

Ken Pratt

Graduates of Solar Car

Ariana Dale

Of the twelve students on the race, six of them recently graduated from Principia, and many of them have consistently contributed to the team since their freshman year. I would like to take a moment to acknowledge each of these seniors for their countless hours of hard work and dedication.

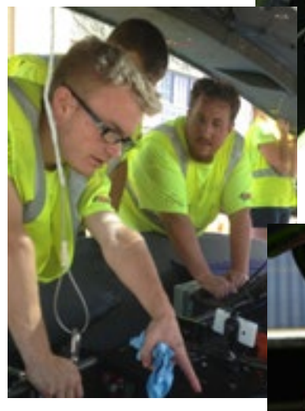


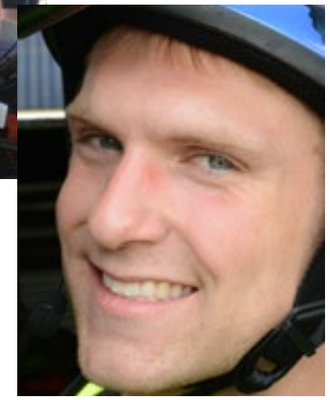
Peter Telschow (14') served as the team's quartermaster on the race. His uncanny ability to quickly locate needed equipment or materials in our garage made him a valuable asset. The team is very grateful for his kind heart and willingness to tackle any task at hand.

Clayton Harper (14') was a last minute addition to this summer's adventure. While he had never participated in the classes during the semester, he became an essential piece in the inner workings of the team. Along with assisting in logistics and directing social media content, Harper kept an incredibly calm and efficient demeanor throughout the race.

Kenneth Stack (14') has been essential to the design of Ra9. He has spent hours researching and troubleshooting aerodynamic designs for four-wheeled vehicles. While Ken may be quiet, he offers a strong presence to the team and is well known for the little twinkle in his eye. Since graduating, Ken has been working at the college as a post-graduate teaching intern for the Physics department.

Kali Mckee (14') is a modern day Renaissance woman. She was involved in almost every part of the car and could articulate its purpose and function with grace at any outreach event. While she did much behind the scenes, we also appreciated her comforting chatter over the radio when she drove the solar car. There was rarely a day when Mckee didn't provide a good laugh to the caravan. She will be going to Abu Dhabi with the team in January.





Garrett Fielding (14') is the team's solar car enthusiast. His knowledge of the history and mechanical aspects of the car goes far beyond expectations and is makes him someone that many look up to on the team. Fielding is currently employed as the lab coordinator for the Chemistry department and will also be going to Abu Dhabi in January.

Brian Ritter (14') has been a key member of the team in and out of the solar car. Between driving and serving as an essential member of the electrical team, Brian always seems to be incredibly focused and quietly determined to overcome any situation. Ritter has been studying electrical engineering at the University of Minnesota and will also be going to Abu Dhabi in January.

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Elsah, IL 62028

Checks payable to: Principia Solar Car Team

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