

The Solar Flare

March 2016



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Abu Dhabi Solar Challenge January 2015

By Annika Fredrikson

Last January, nine students were given the opportunity to travel to the United Arab Emirates to participate in the first ever Abu Dhabi Solar Challenge. It truly was a once in a lifetime experience. Here are some excerpts from our time abroad.

Jan 9: By 8:30pm we had the car running and Jackson was driving around the parking lot. We are in pretty good shape and feel confident enough that after a few hours of work tomorrow morning, we'll be heading to Dubai. On Sunday we will move Ra 9 and our gear to the Yas Marina track to prepare for Monday's tests.

Jan 13: Great news from the first day of scrutineering! In the first day we were able to successfully pass (grade of green) the Mechanical, Electrical, Array, Driver, and Dynamic tests. According to other team members this has been one of the most harmonious, smoothest first day of scrutineering. It really helped

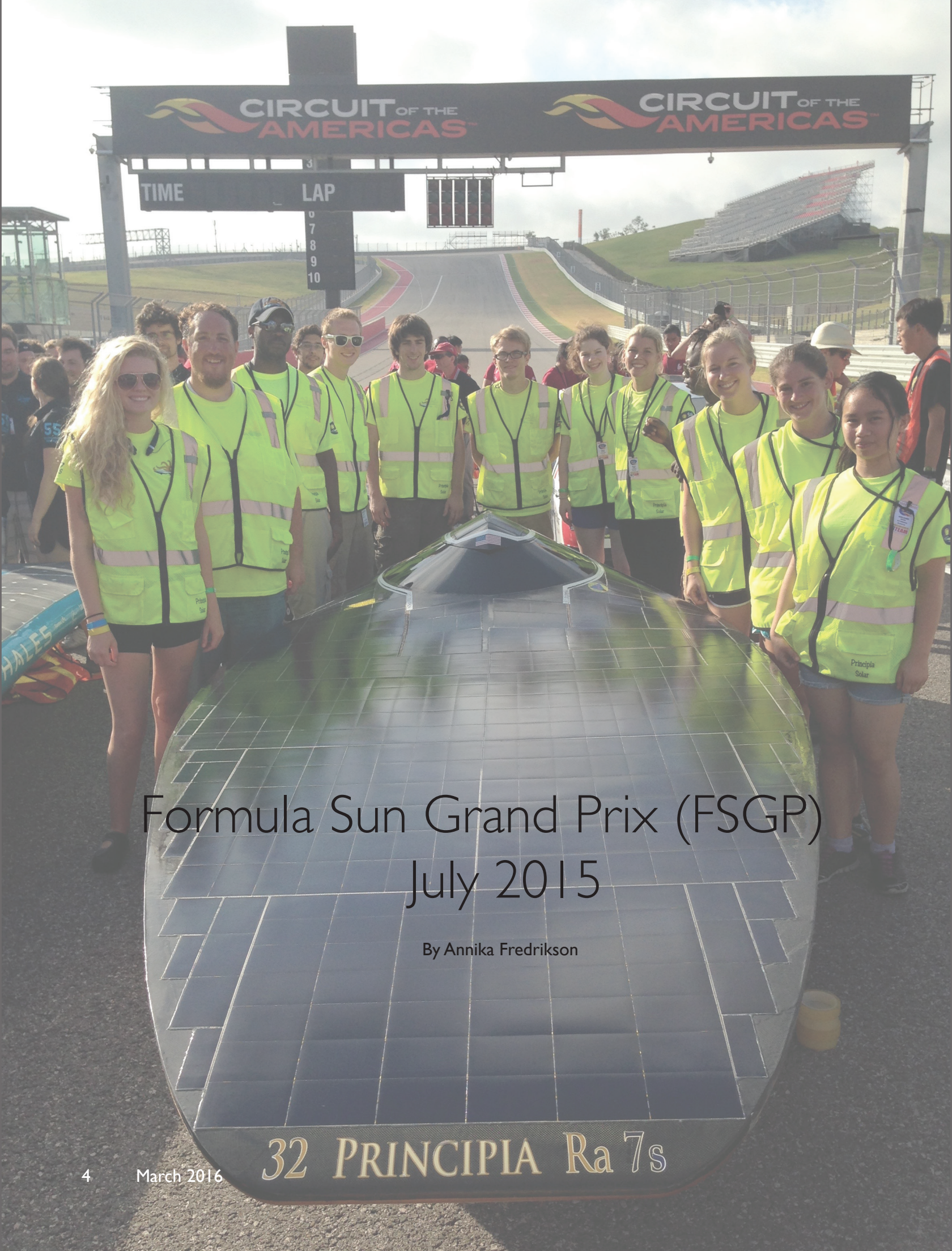
that we were well prepared and that our car was already functioning properly thanks to everyone's hard work during the semester and over the past couple of days.

Jan 18: Today's route took us south from Shams again but then we turned west and made a loop. Essentially we just went the opposite direction as yesterday. It was not as hilly as yesterday's road, but we definitely saw a lot more camels! The weather was quite hazy and we weren't charging much at the beginning of the day. We had to stop for a small electrical problem and then also were going below the speed limit in order to preserve our battery charge. We started in 6th position for the day, but ended up coming in 10th for the day. We are very pleased with how well the car ran and how well the team worked together! We are certainly excited for the races to come.



photos / Steve Shedd & Garrett Fielding





Formula Sun Grand Prix (FSGP) July 2015

By Annika Fredrikson

32 PRINCIPIA Ra7s

photos / Annika Fredrikson &
Tamara Thomas



In July, ten students and recent grads headed down to Austin, TX to participate in the 2015 Formula Sun Grand Prix at the Circuit of the Americas Formula 1 racetrack. As a driver, I can attest that the experience was unforgettable. It was a great opportunity to grow as a team as we welcomed new team members. We were also able to race our dear Ra 7s one final time, and what a car she was. We ended with a 5th place finish overall and earned an unrivaled seventh safety award. We were very pleased with all we achieved, but more importantly everything we learned. Here are a few highlights written during the race.

July 29: Wednesday was a great first day of racing. Tamara started the day in 7th position and quickly moved up to 1st place. After a fast pit stop to check tire pressure on lap 18, Tamara went back out for another 11 laps. After 29 laps total, Tamara came into the pit where we changed all three tires and I got into the car. On my third lap, acceleration cut out right before turn 9 and resetting the car did not solve the issue. The team came out in the rescue van, determined that the umbilical was not fully connected, and corrected the problem. I completed 21 laps as a driver and was just beginning our team's 51st lap around 4pm when acceleration cut out on the big hill before turn 1, leaving me stranded on the hill. Fortunately, Georgia Tech was also stopped on the hill and their team members were able to help me safely get back into pit lane.

July 31: It's been a great week down here in Austin at the Formula Sun Grand Prix. After three days of scrutineering and three days of track racing, we've all grown individually and collectively as a team. Some unprecedented statistics from this year's FSGP: This year 14 of the 15 teams qualified; all teams were present for the first team meeting; all teams made safety their first priority.



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A day in the life of the Australia race team

By Natasha Telschow & Nicole Gerber





photo / Garrett Fielding

“GOOOOOD MOOOOORNING SOOOLARR CARRRR!!!!” is the first thing you hear on the average race day. Shouted by Trey, our hard-working chef, this wake-up call is usually heard around 5:30 in the morning or earlier, depending on the time of the sunrise. This rousing call is quickly followed by 17 people scrambling to pack up their luggage, tents, and sleeping bags so we can prepare for the day. Before the sun even breaches the horizon, Ra 9 is already in position to receive the maximum amount of sunlight it can get before we start racing again.

At around 7:50, we’re all packed up and ready to leave as soon as the clock strikes 8:00. If it’s a good day, we’ll spend the rest of the morning in the vans until our next checkpoint. However, if something goes wrong, it’s all hands on deck as people leap out of the vehicles and get ready to lift the array, change a tire, fix an electrical problem, or help with any number of challenges we might encounter.

The rest of the race day continues in this fashion. If the solar car is running well, then the caravan will stay on the road until the next checkpoint. These checkpoints are mandatory 30-minute stops at a predetermined town along the Stuart Highway. They are great opportunities to switch drivers, refill water bottles, use the bathroom, and stretch your legs. After the checkpoint, it’s back on the

road for the rest of the afternoon until we stop racing at 5:00.

As soon as we’re off the road, the car goes back into charging configuration to soak up as much sunlight as possible before sunset. Once the sun has gone down, we move the car into our campsite and start our end-of-day checks, including a full mechanical check of every nut, bolt, and frame member of the chassis. Each tire is checked over for wear, and any worn tires are unseated and replaced with a brand-new Michelin tire. The unseating and reseating process would give any body-builder a run for his money. In case we need to replace a tire on the road, we always need to have four spare tires seated and filled.

We always have to be prepared for anything that might come our way. If something has gone wrong during the day, the evening is the best time to fix it. This could include debugging electrical issues or remaking mechanical parts for the chassis.

The day ends with another great meal from Trey and the opportunity to experience the joys of the outback. Before drifting off to sleep, we get to look out at the gorgeous night sky, as the southern hemisphere’s constellations shine bright without any light pollution. Our heads hit the pillow around 11:00, and we fall asleep dreaming about solar car and preparing to do the whole thing all over again.

Safety on the go

By Adelaine Biang

Races take effort, commitment, time and money in order to have a full and meaningful competition. But above all safety should be the utmost priority. The World Solar Challenge and American Solar Challenge strongly agree in prioritizing the safety of the competitors. Safety guidelines and safety awareness are scrutinized in order to facilitate an accident free race.

During the American Solar Challenge 2015 in Austin, Texas as well as the World Solar Challenge 2015 in Australia, safety plans and equipment were checked during the scrutineering period, to ensure every team had the proper equipment and protocols to deal with an emergency.

Precautionary guidelines are set and safety equipment is checked for the safety and well-being of the contestants as well as to have an accident free race. Labels in the solar car are noted, especially high voltage signs on the battery and any exposed electrical wiring. In addition, both the batteries and any exposed electrical wiring must be covered to avoid contact

with the drivers. Labels in the battery pack and other emergency buttons should be placed correctly to serve as warning and instruction.

In case of battery fire, the chemical needed to put out the fire, lithex, is needed, as well as gloves, goggles, and a shovel. In addition, fire extinguishers should also be on hand in case of an accident. Extra solar cells must be labeled and every team must have a labeled container for battery disposal.

On the road, safety measures are taken to ensure the solar car and driver are never left alone. A caravan during the solar car race includes a scout, lead vehicle, solar car, chase vehicle, and trailer. Safety equipment including yellow flags, cones, stop signs, orange gloves, whistles, and first aid kits are kept in the lead and chase vehicles that travel with the solar car at all times. Both of the cars also have assigned safety personnel, that have specific roles should a stop be necessary.

These are the precautionary steps taken during the race to hopefully limit any unsafe circumstances.

photo / Steve Shedd



What is a carbon fiber layup?

By Fiona Waller



photo / Garrett Fielding

With the construction of Ra 10 in mind, we spent a Saturday in early November teaching students how to work with carbon fiber. The main body and structure of a solar car is comprised of carbon fiber, a flexible woven fabric that, once a hardening epoxy is added, can be molded to any shape, and becomes rigid, light and strong. Because carbon fiber is such an important material for the production of a new solar car, we need students with hands-on experience prior to the construction of Ra 10.

Many members have never done a layup before (the carbon fiber manufacturing process), so we start off with a simple flat piece. Before the lay up begins, we need a prepared surface. We choose to use stainless steel for flat pieces because it is smooth and easy to acquire. We sand the surface, wax it, and spray it with Polyvinyl Alcohol (PVA), a spray that leaves a thin layer of plastic on the surface. This spray acts as a release agent, preventing the carbon from bonding to the prepared surface. Once our surface is primed, it is time to prepare the carbon fiber pieces.

The final product is like a sandwich. Two carbon fiber sides act as the bread, sandwiching a layer of core material. Surprisingly, carbon fiber

starts out as a roll of fabric. Pieces of the correct size and shape are cut from this roll. For this layup, we cut four such pieces, two for either side of the core material. Our core material is a honeycomb structure made from a polymer called Nomex. Since each piece of carbon has a different weight, each needs its own unique amount of epoxy. Oversaturation with epoxy makes the piece too heavy, and too little epoxy makes the part weak and likely to break. There is a careful balance between too much or too little epoxy, so specific measurements must be made.

Epoxy is then placed on the carbon pieces, and worked into the fibers using spreaders. Once a piece is fully saturated, it is carried very carefully over to the layup surface. The piece is carefully and evenly pressed so that it conforms to the surface shape. Two pieces of carbon are layered, followed by core material, and finally two more layers of carbon. Once all materials are placed, it is time to seal the part in a specialized bag, and place the piece under vacuum. The vacuum places pressure on the part, forcing the layers to bond together. The part is then left to cure for 24 hours, and then it's ready to use. Overall, this process was very informative and a lot of fun!

Meet the new team members



My name is Fiona Waller and I'm a sophomore on the solar car team. I grew up in Chicago, but have also lived abroad in Germany and England. I am a chemistry and education double major. Outside of class, I enjoy singing in the choir, being a chemistry TA, and serving as president of my house. My ultimate goal is to get my Ph.D. in organic chemistry and work for an oil or cosmetic company.

I joined solar car because I wanted a hands-on experience problem solving and working on a team. I read about how the solar car team handled the flooding of their car and electronics last summer and was really impressed. Being part of a team that handles adversity so well will be a great learning experience. The team goals to glorify God and always do our best are inspiring to me.

Hello! My name is Jadwiga Doney, and I am currently a sophomore at the Principia College. I grew up in a small town in Mexico and moved to California when I was 16 years old.

While I was in high school, I was very involved in theatre, mostly because I loved the atmosphere that was created as a result of working together. It felt great to be a part of a group where we all work towards building the same thing. I knew that, while I was responsible for my part, I wasn't alone. At the same time, I have always been good at math. At points I struggle and get frustrated by it, but then I understand it and go back to loving it.

This year I finally decided to join the Solar Car team. It seemed like the best way of combining my knowledge in math and the teamwork atmosphere that I experienced working in theatre. Now I hope to learn how to apply my skills into something practical.



Applying engineering concepts to other vehicles

By Austin Webster & Andrew Huddleston

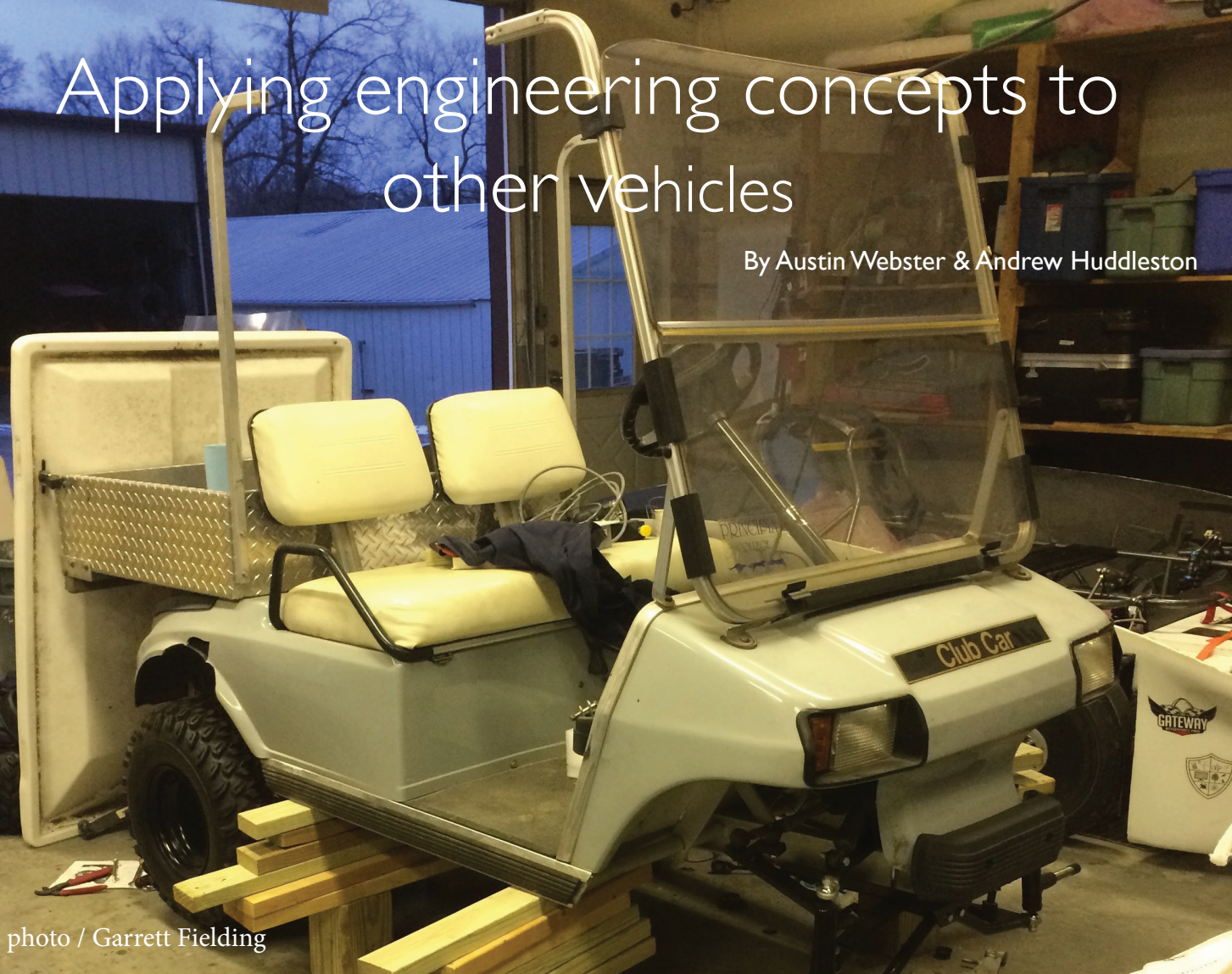


photo / Garrett Fielding

At the beginning of the Fall, the solar car team acquired a golf cart that was donated from some Principia alumni to the Principia Athletic Department. The solar car team is given the task of putting in a higher suspension as well as bigger, more durable tires so that the golf cart is capable of driving on a variety of terrain.

After lifting the golf cart off the ground, we start to take the original wheels off. They come off easily, allowing us to access the suspension. We order a new suspension kit from a special company that allowed us to use parts of the original suspension in tandem with the new parts. We take the bearings out of the front wheel assembly and clean them with diesel. We will repack the bearings with new grease when we put the new wheels on.

After taking most of the front suspension off, we start to reassemble it with the new parts. The new parts included a new leaf spring between the front wheels and new spindles that attached to the existing steering rod.

The rear suspension gives us some trouble, because the new suspension kit gives us little instruction on how we were supposed to complete the job. We undo the back part of the rear leaf springs so that only the front bolts are attached. From there we unbolt the rear axle, which the motor was attached to. To raise the suspension in the back, we bring the rear axle from the top of the leaf spring to the bottom. When we successfully complete that task, we put in spacers from the kit to raise the suspension even more. After this had been done, we reattach the back bolts of the leaf springs and bolt the axle into its new place below the leaf springs. Moving the axle from the top of the leaf springs to the bottom along with the spacers lifted the rear suspension enough to allow us to put on the larger wheels.

This project is almost complete! We just need to finish packing the front bearings with new grease and fit the front wheels on and we should be ready to roll.



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