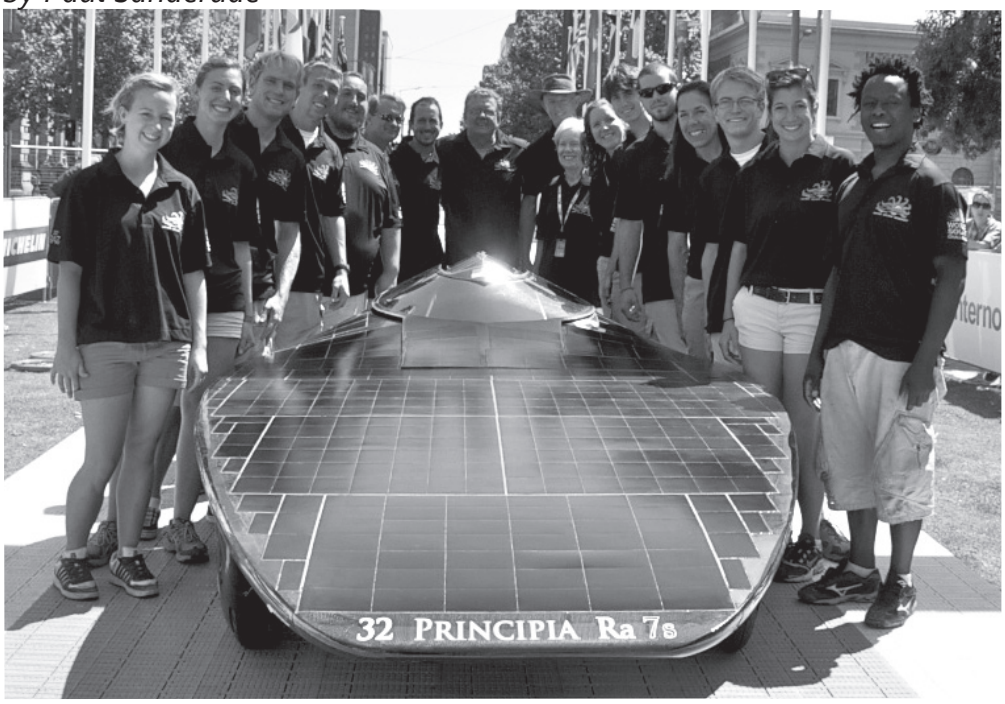
THE
SOLAR FLARE

March 2012

WSC 2011
Crossing the Finish Line!

by Paul Sanderude



WSC 2011 Race Team

After a long 3,000-kilometer journey through the heart of Australia, the Principia Solar Car Team had finally arrived in Adelaide, home of the finish line for the 2011 World Solar Challenge. What a thrilling, yet challenging, experience it had been!

For the majority of the team, crossing the finish line was definitely one of the most rewarding moments of the entire trip. As Justin Sinichko drove Ra 7s through the city of Adelaide to Victoria Square, the team was met by a gathering of other teams that had finished already, race officials, and local fans and media. It was pretty incredible how excited all of the supporters were to see us in our final race moments.

There are a couple of traditions that take place when a solar car team finally finishes the World Solar Challenge and arrives in Victoria Square. The first is that each team celebrates by jumping into the Victoria Square fountain. Our team had a lot of fun in the fountain, and made a few new friends from Japan who joined us as we splashed around in the refreshing water. We even got one of our faculty advisors, Joe Ritter, to jump in the fountain! The second tradition is that the different teams trade t-shirts and other team apparel with each other. I was pretty excited to travel home with many different shirts including ones from: the 2011 World Solar Challenge champions Tokai University (Japan), University of Michigan, Ashiya University (Japan), Stanford University, Team Solar Philippines, University of California at Berkeley, Bochum (Germany), and Durham University (UK).

While we all wished we had performed better in the actual race, in our final reflection the team agreed that at the end of the day we were successful in achieving our two team goals: to glorify God and to always do our best. Learning to step outside of our comfort zones, how to interact with other teams from around the world, and working together on such a large-scale project are life lessons every member of the team will cherish forever. Thanks to everyone for all the support given in the months of preparation leading up to and during the race! We had an incredible time!

A Memorable Undertaking

by Lacey Crabill

"G'day Mate!" This was the greeting I commonly used in my written race updates as well as in my verbal lingo in the Australian Outback. Our team had a fantastic time embracing the "Aussie" spirit; it wasn't long after landing in Darwin that we had had our first taste of ginger beer (Australian for ginger ale), spoke in our best Australian accents, and learned a little more about the native roo.

Stepping onto the red soil in Darwin, we had officially made it to the start of a great Australian adventure: the 2011 World Solar Challenge. And what an incredible challenge it was! We faced unusual stormy weather, road-side fires, daunting road trains, and technical difficulties with our car. Needless to say, the week-long race crossing the Australian continent from Darwin to Adelaide was not easy.

However, since we base our success on our ability to glorify God and always do our best, we accepted the challenge as part of our mission, rather than seeing it as a hindrance. I loved how every team member, each with his or her unique role, came together on this race to execute the task at hand. We attacked every hiccup along the way with enthusiasm and a willingness to recognize the good in all situations. Although we were not the first team to jump into the fountain after crossing the finish line in Victoria Square, we took something more from the experience in its entirety.

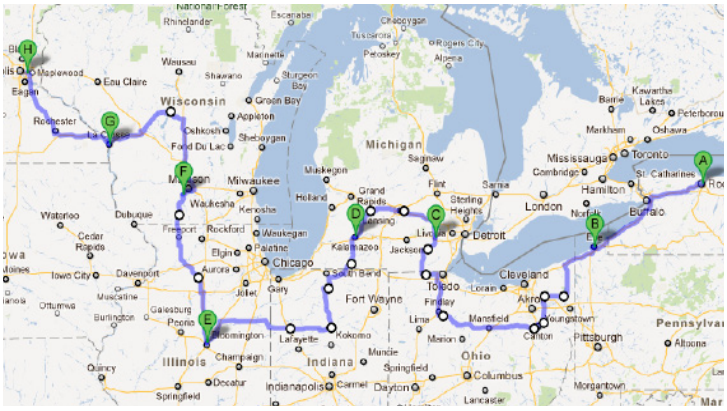
For most of the team, this race was their first opportunity to see solar cars designed and built by teams from all around the world. Specifically, we had the opportunity to help out the University of Delhi (India), shared a campsite with Bochum University (Germany), shared tools with Istanbul University (Turkey), and became closer friends with Cal Berkeley (USA)! Through it all, it was comforting to have all the support we did.

As the official communicator to our supporters along the race, I had a blast writing nightly updates and waking up to the rising sun each morning for the Principia Internet Radio broadcast. Thank you to everyone who listened in and followed the updates! Currently, we are gearing up for the 2012 American Solar Challenge and are ecstatic for the adventures to come. With a few new team members and continuing progress on our car, we are eager to get back out on the open road under the glorious sun!

Next Step:
American Solar Challenge 2012

by Kali McKee

From July 6th - 22nd, Principia Solar Car will be chasing the sun over 1,600 miles across the northern border of the United States of America. Some competing schools consist of the University of Michigan, MIT, University of Kentucky, and Missouri S&T, and we look forward to seeing everyones' improvements. We have accepted 9 students for our ASC race team and over the next couple of months we will be training the newest members of the team. To read more about ASC, check out their website at www.americansolarchallenge.org.



Battery Update

by Brian Ritter

After the World Solar Challenge in 2011, it became clear to the team that testing and improving the battery pack would be top priority for the electrical team in preparation for the upcoming American Solar Challenge. The main problem that needs to be addressed is adjusting the battery protection system (BPS) so that it accurately monitors the state of all the cells in the pack. In order to do this, we are in the process of improving our current system and redesigning some of the circuit boards.

We have also ordered a different type of microcontroller and BPS board and are in the preliminary stages of testing them. However, figuring out how to implement the new system could take a while, especially during the school semester. Because of this, we have set aside the new BPS and are focusing on modifying our current system in the coming months leading up to American Solar Challenge 2012 . While we eventually want to get the new system functioning since it is an improvement over the current one, we know that our current BPS functions and is compatible with our telemetry program.

Along with updating the BPS, we are planning to test our battery cells and collect hard data about their capacity based on current draw. We have set up Bitrode charge/discharge stations and have written a program that charges and discharges cells at different rates, allowing us to identify their capacity at different current levels. With this data we will be able to develop a better race strategy and plan our energy use more efficiently.

The last battery project the team faces is designing a new battery box and cell layout. The battery regulations for ASC only allow 20 kg of Lithium-polymer cells, so we have to decrease our pack size. Since we want to keep our old pack from WSC 2011 intact as a spare, we have started making a new box similar to our old one. The main difference of this new box is that the lid will slide off rather than swing open on hinges. This will allow us to take the lid off while the battery box is still inside the frame of the car, making roadside maintenance much easier.

A Third Taillight

by Tania Lloyd & Jeremy Gilman

Looking ahead to the American Solar Challenge (ASC), Principia's Solar Car team has many projects to work on before Ra7s is ready to race. One of these projects is the addition of a third taillight. While Ra7s already has two taillights, the ASC regulations state that each solar vehicle needs to have three tail lights to be race worthy.

5.9 Lighting

5.9. A Position: Solar cars must have amber front indicators, red or amber rear turn indicators and red brake lights.

5.9. A.1 Turn signals must be located at the front and rear of the vehicle. Brake lights must be located at the rear of the vehicle.

5.9. A.2 ***A third high mounted brake light must be located at the rear of the vehicle canopy.***

5.9. A.3 The turn signals and brake lights must be located at least 25% of the overall vehicle width away from the vehicle centerline.

From: ASC Race Regulations

Considering the shape of Ra7s' body, the only place that a third taillight can be added and meet regulation requirements is along the spine of the car. Team members are working to calculate the angle at which the holes need to be drilled to best optimize the brightness of the fiber optics, since they will need to be clearly visible during daylight. The spacing of the individual fiber optic cables is also important because we do not want to weaken the spine by drilling holes too closely together.

This means testing a range of angles and spacing and eventually creating a stencil that will allow us drill at a precise angle. The stencil will be crafted out of aluminum and designed to fit along the spine of Ra7s. Once the holes are drilled, fiber optic cables will be epoxied into the holes and connect to an aluminum box of LEDs placed inside the upper body of Ra7s. The ends of the fibers are then shaved down, buffed, and waxed in order to recreate a smooth, aerodynamic spine.

Implementing a third taillight acceptable to ASC regulations is one of the various projects the team will be working on throughout the semester.

Carbon Fiber 101

by Josh Curry

At any given moment during a race, solar cars have a limited amount of energy available to them. Therefore, it is essential to design a solar car as lightweight as possible in order to minimize power usage. At the same time, it is vital that the shell of a solar car remains aerodynamic and strong. What's the best option for a strong, lightweight, and shapeable material? Carbon fiber. Used in solar cars throughout the world, carbon fiber bodies accomplish all of the afore mentioned requirements. Carbon fiber can also be found in a variety of different products including bike frames, car parts, fishing rods, golf clubs, laptops, and countless others.

Carbon fiber is very malleable, like a sheet of cloth, before being impregnated with epoxy (a mix of hardener and resin). Carbon fiber has attributes similar to fiber glass, and can cause irritation when exposed to skin, so "work clothes" and gloves are recommended when handling the material. Generally, the process by which a carbon fiber part is created is called a layup, and takes place in a fiberglass mold or on a flat steel surface. In preparation for a layup there are three essential steps. First, the mold surface must be waxed. Second, it is sprayed with several layers of Polyvinyl Alcohol (PVA), an anti-stick spray.

Carbon Fiber 101 cont...

PVA allows pieces to be removed from the mold and helps preserve the integrity of the mold so that it can be used again without epoxy stains. The third step is to cut the carbon fiber to size. A standard layup requires four sheets of carbon fiber and a sheet of Nomex honeycomb core.

Once everything is cut to size and the mold is prepped, a sheet of carbon fiber is laid out on a flat, plastic-covered surface and the epoxy is applied, leaving no dry spots. The sheet is then slowly transferred to the mold. This is a difficult process because carbon fiber has a tendency to stretch and deform and the epoxy is extremely sticky. The process is repeated until all layers are in the mold (2 carbon fiber sheets, Nomex, then two more carbon fiber sheets).

In order to cure properly, the layers of carbon fiber and Nomex need to be kept under a vacuum. To begin the vacuum bagging process, sheets of polyester and cotton are placed over the top layer of carbon fiber. A sheet of plastic vacuum bag is then added on top of the mold and sealed with vacuum tape, making the layup completely air tight. Then, vacuum pumps are spaced around the part to remove air and apply pressure evenly across the surface of the layup. The pumps are left running for a minimum of 24 hours.

Carbon fiber can be found throughout a solar car. Knowing how to do a layup is a skill everyone on the team should know and understand. Not only is it important to fixing and improving the body of the car, but the knowledge is also valuable when designing and building a new solar car.

Tire Tutorial

by Garrett Fielding and Ann Sebring

Among the most important factors to take into consideration in the design of a solar vehicle is the tire selection. Rolling resistance, the friction caused by contact between tires and the road, accounts for the largest portion of drag when moving at low speeds and a significant portion at high speeds, second only to aerodynamics. In order to be prepared for the upcoming race, the team will need several sets of tires. Ra7s runs on three wheels, so factoring in practice runs on campus, testing before the race, scrutineering tests, and each day of racing, the team will need close to 35 tires. Since high performance tires can cost up to two hundred dollars per tire, a substantial portion of our racing fund is dedicated solely to the purchase of decent tires.

During Principia's most recent race, the 2011 World Solar Challenge in Australia, Principia was required to change tires in order to meet a new race regulation: tires had to be approved for highway use. Due to time constraints and the inability to procure funds to purchase the brand of tires the top teams were running, the team was forced to settle for treaded tires most commonly found on mopeds. The extra tread caused an unnecessary increase in friction between the tires and road. Complicating the problem further, they also were low-pressure tube tires. When weight is placed on the tires, they flex more, causing more surface contact with the road and even more rolling resistance.

Fortunately, the upcoming American Solar Challenge has not placed restrictions on tire selection. Two major factors that play a role in choosing an efficient tire include: little to no tread because slick tires cause the least rolling resistance and high pressure tires which result in less flex and less contact with the road surface. Ra7s may be built to be aerodynamically sound, however, tire selection has proven to be crucial, as was discovered in Australia.

The team is currently hoping to race using Bridgestone Ecopia EP 80 tires. If all goes well, it should be smooth driving from Rochester to St. Paul this summer.

A New Perspective

by Lisa Lewis

I first heard of the Solar Car Team as a student at the Principia Upper School. The team would travel to the Upper School to do demonstrations about three times a year. During these demos they would show off the car in detail and talk about their past race experiences. I remember looking up to the college students on the team, but never imagined myself actually being on the team. I thought that to be on the team you would need to be majoring in engineering, or that you have to be a complete genius, but this is not the case. Although the solar car experience has a definite appeal for people interested in science and math, the team has a history of active team members that majored in non-math or science based majors, many of whom even studied English during their time on the team. This "everyone's included" attitude is adopted and supported by the experienced team members and has enabled the group to grow as a competitive and diverse team.

As a non-science/math major, the team's inclusivity made me feel less intimidated about joining and has enabled me to ask questions when I need help. All that said, I am still catching up on understanding all aspects of the car, but with the help of teammates, I continue to learn more as each day progresses.

Although the team is made up of a variety of different types of people, we all express Christian Science in every project we take on. The solar car team is an incredible group of young people who make spiritual perfection and glorifying God as their top priority. We're the only solar car team that bases their work around the idea of limitless supply and energy. I feel we derive our greatest strength from our devotion and humility toward God, which we rely on every step of the way.

I am still finding my place on the team but I know I won't have any trouble finding help or getting questions answered. Although I am not majoring in engineering, or any subject that corresponds with solar car, I've already learned so much in the past eight weeks. I cannot wait to see what the Solar Car Team has in store over the coming months!

Interview with Gabe Korinek

by Lisa Lewis

Q: How did you find out about the team?
A: "Whenever I talked about what I'd be majoring in at Principia, people always brought up the solar car project and its awesome reputation. When I saw the team during my visiting week, I knew joining the solar car team would be a top priority for me. It all turned out pretty well."

Q: Why else did you join the solar car team?
A: "When I was in high school, I was part of a robotics team, called 'FIRST Robotics.' It was a great experience and we even placed 3rd internationally. For me, it was a lot of fun to work with friends to design, test, and build different ideas. So when I heard about the solar car team, I knew it was something I would really enjoy. Also, I am majoring in engineering, and it would be a great experience to supplement my major."

Q: What most excites you about the solar car?
A: "As a person who has always been interested in building things, I love the concept of a solar car team. My previous experience with robotics showed how much can be accomplished when a group of passionate people get together, share different ideas and help each other out in order to create something new. I hope to see that happen with the solar car team this year and in consecutive years."

Interview cont...

Q: How are you contributing to the team?
A: "As new member on the team, my involvement in the designing and building of the car is somewhat minimal. However, with this team it's really easy to become involved and work with some of the other experienced members on projects, which is what I've been doing for the most part."

Q: What are your thoughts about the team?
A: "I'm really impressed with the organization and wealth of knowledge the team has and is willing to share with new team members. I'm equally astounded by the turnout for the team, given Principia's small size and Liberal Arts status. I think it's awesome people with varying interests are joining solar car."

Q: How involved do you plan to be with the solar car team?
A: "After my freshman year I'll be more involved in solar car. Right now, I have heavy workloads and summer work, though I'm constantly making time for some of the projects."

WORD SEARCH

by Kali McKee

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Array
Battery
BPS
Carbon Fiber
Cells
Energy
Fiber Optics
Finish Line
Principia
Solar
Sun
Taillight
Team
Tire
Vehicle

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Solar Car Alumni:

SAVE THE DATE!

Meet us at the ASC finish line in St. Paul, MN, on July 21st to support this year's race team and attend a Principia Solar Car Alumni reunion. Contact us at solar@prin.edu for more information.

Adopt-A-Tire!

Or three!

As you read in *Tires Tutorial,* tires play an essential role in the success of a competing solar car. Principia Solar Car is looking to purchase 35 Bridgestone Ecopia EP 80 tires. If you adopt one tire for $100 or a complete set of three tires for $300, you will receive a never before seen official black Principia ASC 2012 Race Team tshirt and a personal postcard from a team member letting you know when we are racing YOUR tire(s). All you have to do is send a check to the address listed at the bottom of this page and label it, "Solar Car Project: Adopt-A-Tire"!

To receive updates on what we are doing each week, join us at:
http://www.principia.edu/solar

Please address contributions to:

Fundraising Chairman
Principia Solar Car Project
Elsah, IL 62028

Checks payable to: Principia Solar Car Team

All contributions to our 501(c)(3) educational organization are gratefully accepted and are tax deductible. Please include a corporate matching form if your employer has such a program.