

# THE SOLAR FLARE



June 2012



*ASC 2012 Race Team*

## *A Letter from the Team Leader*

*by Lacey Crabill*

### **Dear Solar Followers,**

As we continue on this exciting journey toward the American Solar Challenge (ASC), it is vital that the team focus on its sole priority: to glorify God. We have been working together on the development of Ra 7s for over two years now, and it is realistic to say that we have met and conquered many obstacles from the beginning. Since the return of Ra 7s from Australia in December, we have reassessed several aspects of the car including (but certainly not limited to) our steering, brakes, tires, battery pack, and horn.

Now that summer break is currently underway, most of the race team is on campus, working diligently to see Ra 7s to the start line of ASC in Rochester, New York. Without the team's focal point on humility, love, and respect for one another and our competitors in the upcoming race, we could never be successful in our objective to be the best we can be.

Our race team consists of six students, four recent graduates, four advisors, and three race supports; all significant individuals who express noble qualities of persistence and reverence toward the art of solar car racing. With each of these qualities of good expressed, we are fulfilling our primary objective. After scores of long working hours, we are anxiously awaiting this summer's race. Needless to say, we are enthusiastic to see Ra 7s out on the open road in the northeast this July!

We thank you for your continued support of our team on this remarkable journey.

Best,

Lacey Crabill  
Principia Solar Car Team Leader

# Just around the corner: American Solar Challenge

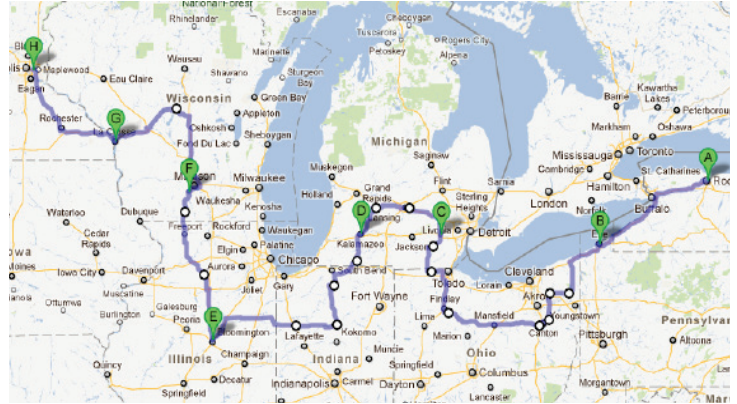
by Kali McKee



Principia Solar Car has been working hard over the past 6 months to prepare Ra7s for the American Solar Challenge (ASC). This year, 18 teams will meet a week before the race in Monticello, New York, for scrutineering and participating in the Formula Sun Grand Prix, the qualifying track race for ASC. ASC will be held July 14 – 21 taking the teams through eight states and traveling more than 1,650 miles starting in Rochester, New York and finishing in St. Paul, Minnesota.

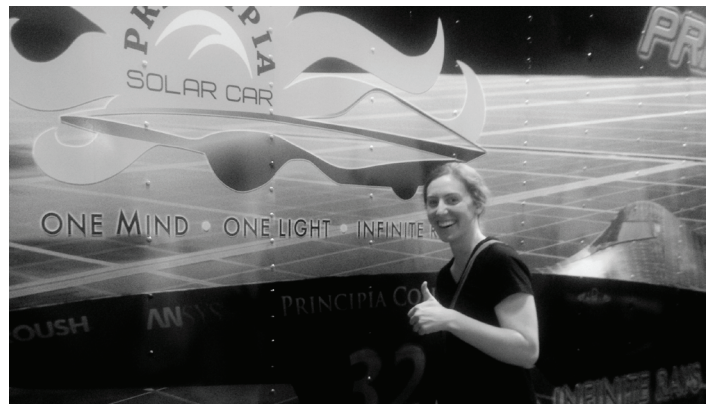
## Route Schedule

- **Fri, July 13th:** Display day at Rochester Institute of Technology in Rochester, NY
- **Sat, July 14th:** *Start in Rochester, NY; must reach stage stop in Erie, PA*
- **Sun, July 15th:** Start in Erie, PA; must reach Mansfield, OH checkpoint
- **Mon, July 16th:** Finish in Ann Arbor, MI
- **Tue, July 17th:** Start in Ann Arbor, MI; must reach Kalamazoo, MI checkpoint
- **Wed, July 18th:** Finish in Normal, IL
- **Thu, July 19th:** Start in Normal, IL; must reach Verona, WI checkpoint
- **Fri, July 20th:** Finish in La Crosse, WI
- **Sat, July 21st:** *Start in La Crosse, WI; finish in St. Paul, MN*



Not only is the route far from flat and straight, but the race is designed with a special twist. Throughout the eight days, teams will be required to meet 30 minute media checkpoint deadlines and regroup at stage stops for controlled overnight stays in four different cities, thus treating the next morning as a new starting line. Teams are required to reach each stage stop by a designated time which may require teams to trailer in order to reach each stop by the time deadline. Listed below is a general schedule of the race identifying all checkpoints and stage stops.

Feel free to check out our website [www.principia-solar.edu](http://www.principia-solar.edu) for more information on Ra 7s and the race team. To learn more about the American Solar Challenge and the participating teams, feel free to visit their website [www.americansolarchallenge.org](http://www.americansolarchallenge.org).



Team Leader, Lacey Crabill,  
admiring the new trailer wrap.

# Packing Basics

by Lisa Lewis & Lacey Crabill

In the words of a former team leader:

*"Everything you bring will get dirty, greasy, crushed, eaten upon, and sat on during the trip."*

Each team member will have one main piece of luggage with them, containing all the necessities needed to survive a solar car race. With six team shirts, some durable pants, and a nice team polo, one doesn't need much else. Most of the luggage we bring involves supplies needed for safety, mechanical, electrical, the car's body, the array, and driving. These supplies are distributed appropriately throughout our lead, chase, scout, and truck vehicles.

During the race, we use these supplies for frequent check-ups on the car, maintaining a safe environment, and keeping the driver comfortable. Since

## The Tools We Use

by Ann Sebring

While working on the solar car, we use many tools like wrenches and power-saws. But we also use many spiritual tools to lift the mental thoughts of each team member from things that would present limitations or challenges. Such mental work clears the way and removes obstacles that would slow progress.

Since spring break 2012, we've had the wonderful support of a new team member: practitioner, Gardner Fogg. Gardner spoke with the team at the beginning of spring break and gave us a gift: a spiritual toolbox. Inside were the following tools: Watchfulness, consistency, purity, obedience, moral courage, specificity, spiritual sense, humility, love. The purpose of the "Tool Box" was to provide us with tools to work with each day and eliminate any challenges we encounter.

During the semester, readings were chosen each week to begin Monday team meetings and Saturday shop time. Readings could come from

we have so many supplies and tools with us, we ensure that our supply boxes are clearly labeled and organized prior to the race. This allows for easy access when the items are desired.

Finally, our team forages constantly. We've learned that a team with an endless appetite needs to be well fed. Along the race, our dedicated scout drivers take care of all of our snacking and feeding needs. Although Scout may be the vehicle with the healthiest food, many solar car members, after participating in the World Solar Challenge last October, quickly learned that lead (the van in front of the solar car) was notorious for having the best snacks. Let's just say that the biscuit tin will be kept under close supervision throughout this coming race.



any piece of literature and were used as a foundation for a positive and successful day of work. Metaphysical heads, Ann Sebring and Tania

Lloyd, would then encourage the team to share ideas and stories applicable to the subject of the day. Each tool provided inspiration which in turn helped with team building activities, car projects, and overall team and car performance.

Testing and finishing Ra 7s is crucial for the team's performance in the American Solar Challenge. Metaphysically preparing the team is crucial for accomplishing the team goals: Glorifying God, and doing our best. As we finish preparing for the American Solar Challenge, we will continue to use our nine "power tools."



# Sparks of Progress

by Brian Ritter

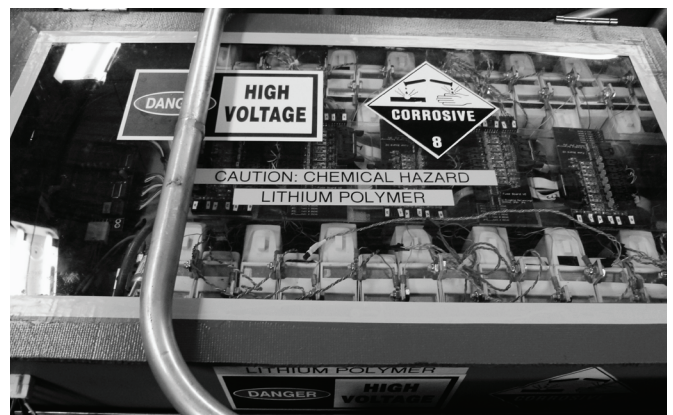
**E**lectrically, Ra 7s has seen many changes since the World Solar Challenge last October. One major change has been the reworking of our battery pack, including the configuration and protection. We have assembled new circuit boards for our BPS that decrease faulty signals due to poor connections, among other factors. The use of a conductive silver paste between modules has improved conductivity throughout our entire string of cells. This combined with brand new cells has allowed us to create a much more efficient battery pack.

Our new pack also has a new battery box to rest in inside the car. This box now has removable hinges that let the lid to slide off, allowing us to test the cells and make modifications while the pack is sitting in the chassis. Roadside fixes will now be quicker and easier thanks to this upgrade.

Not to be left out, our supplemental battery pack, which runs the auxiliary systems on the car, has a new casing as well. This box has been printed using our 3D printer and has slots for ventilation and connectors built into it. The entire box can easily be removed from the car and charged at night

since it is separate from the main pack, which the ASC regulations allow. With a higher voltage and around twice the capacity, our new supplemental pack will provide more reliability and power.

Now that most of our electrical systems are connected inside the car, we have begun to calibrate the telemetry system to give us accurate data. Already we have mostly accurate data on each cell as well as speed and current going to the motor controller. The driver display on the car can cycle between several screens, which allows the driver to see the state of each cell should the need arise. All of these improvements are sure to help us in the race this July.



# We Needed a Brake!

by Garrett Fielding

**W**hile preparing Ra 7s for its upcoming race across the United States, we have taken the opportunity to upgrade several crucial mechanical components of the car. In accordance with a regulation change, our braking system is currently undergoing such improvements. The American Solar Challenge (ASC) regulations state, "Each brake pad used in the braking systems must have a contact area with the brake disk that is greater than 6.0 cm<sup>2</sup>." Previously, we used Avid brand mountain bike brake calipers. Although they worked successfully for us, the size of the pads are too small and do not meet the updated ASC regulations.

Thus began the extensive search for brake calipers that were small enough to fit where our old ones did, worked with our current thickness of brake rotor, weighed as little as possible, and had large enough brake pads to meet ASC regulations.

After an extensive search, we discovered Martin Custom Products (MCP) 650 brake calipers. Although heavier than our mountain bike brakes, they weigh only approximately one pound each, which was far lighter than other calipers we found. These seemed to meet our needs perfectly.

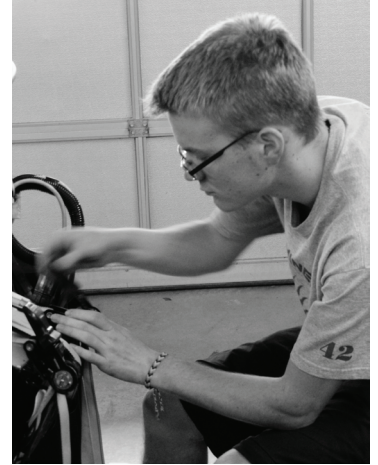
## ***We Needed a Brake! cont...***

Ordering a single test caliper, the mechanical team set about designing a way to implement this new brake into our current system. Using NX, the same 3D design software used to design the car, we spent several hours brainstorming a variety of ideas and designs to mount the brakes.

Once we determined that we had a reasonable part that would successfully mount the new caliper to the kingpin of the car, we used our rapid prototyping 3D printer to fabricate a test part. We continued to modify our design several times before finally achieving a design that held the brake at the correct angle, relative to the mounting brackets for our old brakes, and at the right distance in order to fit around the rotor.

Having now ordered 5 more calipers, we now have 4 brakes (2 for each side of the car), as well as 2 spares. The next task required to delivery of our mount design to Dugan Tool and Die, a machine shop located near Alton Illinois, to have our parts fabricated out of chromoly steel which is a high carbon steel alloy containing both chromium and molybdenum.

Once implemented, the new brakes became just a small part of the new and improved Ra 7s as we finish preparing for the 2012 American Solar Challenge.



# *A Turn in the Right Direction*

*by Gabe Korinek*

**A**mong the many systems being renovated in preparation for the American Solar Challenge, the Principia Solar Car team has designed and built a new steering system. The previous system had many faults, mainly the ten plus degrees of play between the steering rod and rack and pinion (the gear that moves the wheels left and right) and difficulty of maintenance on the system. The new system was designed to minimize play, be easier to maintain, and eliminate the chain connection, the source for most of the previous Ra 7s steering problems.

The old steering system was adopted from previous, similar setups on older solar cars in which the steering rod ran parallel to the ground, below the rack and pinion and toward the front of the car. Instead of angling the steering rod upward to connect to the rack and pinion, the team fashioned together a bike chain and two small sprockets to make the connection. During the 2011 World Solar Challenge in Australia, it was found to be finicky and unreliable. The main culprit was the slack in

the bike chain that connected the steering rod to the rack and pinion.

In implementing this system for Ra 7s, there wasn't enough time for proper testing to meet the deadline for the 2011 World Solar Challenge in Australia. The consequences of the lack in testing were very serious. According to current solar car driver, Brian Ritter, the front wheels would oscillating left and right at speeds as slow as 35 mph, which made driving in a straight line one of the biggest driving challenges.

The new steering system uses two universal joints to connect the steering rod to the rack and pinion. This design replaced the chain and sprockets with a more reliable system and minimized the play in the system, making the car safe and manageable. The team has fully implemented a functional steering system which has undergone extensive testing on and off campus. With the new system, Ra 7s is safe to drive at higher speeds and has thus eliminated steering from being a limiting factor in overall performance.

# A Special Thank you: Brian Kamusinga

by Kali McKee

**Name:** Brian Kamusinga

**Hometown:** Nairobi, Kenya.

**College degree:** BS Chemistry and Physics, minor in Mathematics.

**Future Plans:** Graduate School for a PhD in Chemistry at Washington University.

**Favorite Class:** Organic Chemistry

**Q: How long have you been a member of Prin Solar Car?**

A: 5+ years.

**Q: How many races you have been on?**

A: 4 races.

**Q: What was your role on the team?**

A: I first worked with composites and body, then I was head safety, and currently I work with the electrical team.

**Q: What do you like about Solar Car?**

A: The ability to make things and experience real life problem solving.

**Q: What was your favorite race and why?**

A: My favorite race was American Solar Challenge 2008, because it was fun racing Ra 7.

**Q: What was special about Ra 7?**

A: I was there for the design, building, testing, and racing of it. Plus I like gallium arsenide solar cells.



If asked, I would say that Brian Kamusinga (aka BK or Brin) played a significant role in my experience so far at Principia College. I, like many others, have had the privilege of knowing and working with Brin through solar car among many other projects and venues. Brin joined Principia Solar Car as a freshman five years ago and has spent countless hours working on the project ever since. Brilliant while practicing all sciences, it has been especially exciting to watch Brin working on the solar car.

This fall, Brin will be leaving Principia College to attend Washington University and study for a PhD in Chemistry. With that in mind, I am writing to give a special thank you to Brian Kamusinga, my mentor and friend. I speak for the team when I say that Brin will be missed (even though we all know he will be back). Thank you Brin, for sharing your knowledge and understanding with everyone. You have truly taught us how one can express the omnipresent Mind.

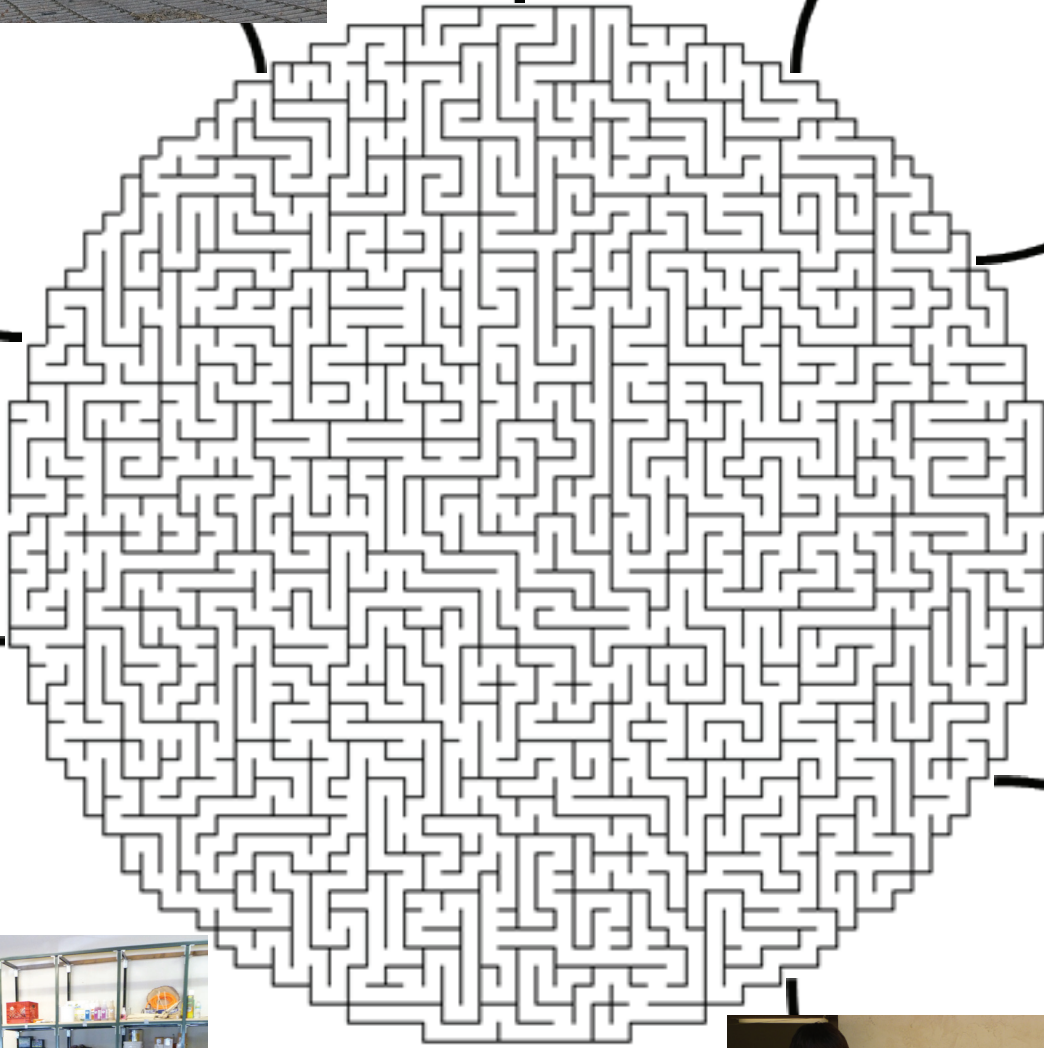
We love you!!

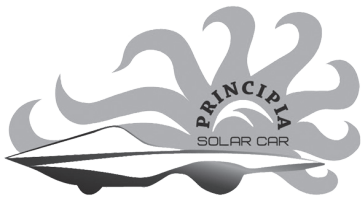
Love,  
The Team



# Sunny Maze

by Kali McKee





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## Attention Supporters:

### **SAVE THE DATE!**

*Meet us in St. Paul, MN, on July 21st to support Principia Solar Car as the team crosses the ASC finish line. Contact us at [solar@prin.edu](mailto:solar@prin.edu) for more information.*



## ***Sponsor A Team Member!***

Since "Project: Adopt-A-Tire" was such a hit, we thought we would give you the opportunity to adopt something even more exciting. For only \$285, you can adopt a Principia Solar Car Race Team Member! A portion of the \$285 will go towards feeding the team member for the race. If you are interested in learning more about the 2012 ASC Race Team, feel free to check out our website at [www.principia.edu/solar](http://www.principia.edu/solar).

In order to adopt a team member, 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 Team Member"! You are welcome to specify which team member you would like to adopt, and not only will you receive personal postcards during the race from your adopted team member, but you will also receive a special Principia Solar Car memorabilia and postcard after the race.

The remaining portion of the \$285 will go towards the future of Principia Solar Car. This fall, the team will begin designing and modeling our new car... Ra 8! Thank you for all of your support!!

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.