Innovators Educational Foundation (IEF) is a non-profit 501(c)3 organization that organizes the collegiate solar car events. IEF is made up of a core group of dedicated volunteers, mostly former competitors, that know first-hand the value of a hands-on, multidisciplinary, innovative project to the education experience. In addition to experiential learning, these solar car events promote energy efficiency and raise public awareness of the capabilities of solar power.

If you are interested in forming a team to participate in future events or providing support to the events as an event partner, sponsor, or volunteer, please contact us!

The Formula Sun Grand Prix is not in any way associated or affiliated with the Formula 1 companies, FORMULA 1 racing, or the FIA Formula One World Championship.
Promoting educational excellence and engineering creativity, the American Solar Challenge (ASC) and Formula Sun Grand Prix (FSGP) are collegiate student design competitions. Teams from the US, Canada, and around the world design and build solar-powered vehicles within a set of regulations. Once at the event, these vehicles are put through a series of inspections, a process known as scrutineering. Teams that successfully pass scrutineering and the track qualifier will then take on the 900+ mile journey commemorating the bicentennial of the Santa Fe Trail.

**SCRUTINEERING**
**JULY 27-29**
The solar cars undergo a series of inspections covering all aspects of the car, including electrical systems, mechanical systems, body and sizing, dynamic testing, and more. Inspectors check that the solar cars are built in alignment with the regulations and have all required safety features. Passing scrutineering is a big accomplishment for the teams and a requirement to participate in the track and road events.

**FORMULA SUN GRAND PRIX**
**JULY 30-AUGUST 1**
The Formula Sun Grand Prix is a 3-day road-course track event, where teams aim to complete as many laps as possible in the allotted 24 hours of drive time. With no lunch break, teams strategize their pit stops for driver and tire changes while carefully monitoring the weather and managing the car’s energy from the sun. Solar cars that complete a minimum number of laps qualify to participate in the American Solar Challenge.

**PUBLIC DISPLAY DAY**
**AUGUST 2**
As a transition between the track and road events, this day includes meetings, training, and other preparations while providing the public an opportunity to come see the solar cars on display at Independence Square. The multi-occupant vehicles will also go through practicality judging, which is a factor in their final score.

**AMERICAN SOLAR CHALLENGE**
**AUGUST 3-7**
The goal of the American Solar Challenge is to complete as many miles as possible within the given time constraints of the event. The base route for 2021 is nearly 1000 miles. Teams that have extra energy available will be allowed to drive additional optional loops at select locations to further demonstrate the capabilities of their solar cars. The nominal driving day is from 9am–6pm. Each solar car is escorted by lead and chase vehicles that carry the other team members and equipment for roadside repairs. For two hours in the morning and evening, teams are able to charge their batteries using the car’s solar array, angling the array toward the sun for maximum exposure. During these non-driving hours, teams can perform maintenance on the car, check the weather, and determine their strategy for the next day.
Meet the Teams

Representing a variety of universities, these teams have taken on the nominal 2 year project of designing, building, and testing a solar powered vehicle to prepare for competition. The teams are split into two classes. The single-occupant vehicles seek to optimize energy efficiency for one person whereas the multi-occupant vehicles are also concerned about space for passengers and practicality features. While both types of solar vehicles are similar in many ways, some key differences are taken into account in the scoring of the classes for the event.

- Single Occupant Vehicle (SOV)
- Multi Occupant Vehicle (MOV)

**Iowa State University**
- #9 Eliana
  - L x W x H: 4.98m x 1.12m x 2.10m
  - Weight: 415kg
  - Array: 123W SunPower St/Spectrolab GaAs
  - Batteries: 16.3kWh Li-Ion (71.2kWh)
  - Motor: 2 Mitsubishi M2096-III
  - Wheels: 4 Bridgestone Ecopia 18"
  - Chassis: Carbon Fiber/Kevlar Composite

**Illinois State University**
- #17 Mercury 6
  - L x W x H: 4.50m x 1.40m x 1.10m
  - Weight: 220kg
  - Array: 800 SunPower Silicon
  - Batteries: 5.2kWh Li-Ion (19.7kg)
  - Motor: 1 Mitsubishi
  - Wheels: 4 Carbon Fiber 18"
  - Chassis: Carbon Fiber Monocoque

**University of Illinois at Urbana-Champaign**
- #22 Brizo
  - L x W x H: 5.00m x 1.20m x 1.00m
  - Weight: 170kg
  - Array: 1000W SunPower Silicon
  - Batteries: 5.23kWh Li-Ion (20kg)
  - Motor: 1 Mitsubishi
  - Wheels: 4 GH Craft Carbon Fiber 16"
  - Chassis: Semi-Monocoque Carbon Fiber Panel

**Georgia Institute of Technology**
- #49 Endurance
  - L x W x H: 5.00m x 1.25m x 1.21m
  - Weight: 200kg
  - Array: 865W SunPower Silicon
  - Batteries: 4.7kWh Li-Ion (20kg)
  - Motor: 2 Marand
  - Wheels: 4 GH Craft Carbon Fiber 16"
  - Chassis: Carbon Fiber Semi-monocoque

**NC State**
- #99 SPX
  - L x W x H: 4.15m x 1.74m x 1.44m
  - Weight: 1212kg
  - Array: 1000W SunPower Silicon
  - Batteries: 26kWh Lithium Titanate (280kg)
  - Motor: 1 Emmix 228
  - Wheels: 4 BMW D Wheels 19"
  - Chassis: Steel Monocoque

**University of Kansas**
- #785 Astra
  - L x W x H: 4.50m x 1.25m x 1.00m
  - Weight: 500kg
  - Array: 5kWh Li-Ion (20kg)
  - Motor: 1 QS Motor
  - Wheels: 4 CST1716" wheels
  - Chassis: Chromoly Steel Tube Frame

**Appalachian State University**
- #328 ROSE
  - L x W x H: 4.74m x 2.10m x 1.24m
  - Weight: 500kg
  - Array: 1212W SunPower Silicon
  - Batteries: 18.9kWh Li-Ion (73kg)
  - Motor: 2 Mitsubishi M2096-D3
  - Wheels: 4 7075 Aluminum 16"
  - Chassis: Carbon Fiber Sandwich

**University of Kentucky**
- #3 Gato Del Sol VI
  - L x W x H: 5.00m x 1.74m x 1.14m
  - Weight: 249kg
  - Array: 970W SunPower Silicon
  - Batteries: 4.5kWh Li-Ion (20kg)
  - Motor: 2 Mitsubishi 2096D3
  - Wheels: 4 Aluminum 16"
  - Chassis: Aluminum Honeycomb/Fiberglass Skin

**Western Michigan University**
- #30
  - L x W x H: 3.80m x 1.70m x 1.15m
  - Weight: 250kg
  - Array: SunPower Silicon
  - Batteries: 5.1kWh Li-Ion (30kg)
  - Motor: 1 Marand
  - Wheels: 4 Moped 16"
  - Chassis: Carbon Fiber/KeVLar Composite

**Princetia College**
- #32 RA XI
  - L x W x H: 3.80m x 1.80m x 1.07m
  - Weight: 170kg
  - Array: 800W SunPower Silicon
  - Batteries: 4kWh Lithium Polymer (20kg)
  - Motor: 2 Mitsubishi
  - Wheels: 4 Carbon Fiber 16"
  - Chassis: Chromoly Steel Spaceframe

**University of Minnesota, Twin Cities**
- #35 Freya
  - L x W x H: 5.00m x 1.90m x 1.20m
  - Weight: 531kg
  - Array: 1000W SunPower Silicon
  - Batteries: 19.5kWh Li-Ion (66kg)
  - Motor: 2 Custom In-house
  - Wheels: 4 6061-T6 aluminum 22"
  - Chassis: Carbon Fiber Monocoque

**University of California, Berkeley**
- #6 Zephyr
  - L x W x H: 4.92m x 1.77m x 1.07m
  - Weight: 215kg
  - Array: 900W SunPower Silicon
  - Batteries: 4.8kWh Li-Ion (20kg)
  - Motor: 2 Mitsubishi M 1096-III
  - Wheels: 4 GH Craft CFW-S16-94B 16"
  - Chassis: Aluminum Spaceframe

**University of Pennsylvania**
- #828 ROSE
  - L x W x H: 3.00m x 1.60m x 1.07m
  - Weight: 183kg
  - Array: 987W SunPower Silicon
  - Batteries: 4.94kWh Li-Ion (20kg)
  - Motor: 1 Mitsubishi 2096D-II
  - Wheels: 4 GH Craft Composite 16"
  - Chassis: Carbon Fiber/Aluminum Honeycomb

**MIT**
- #4 Nimbus
  - L x W x H: 4.06m x 1.60m x 1.02m
  - Weight: 183kg
  - Array: 865W SunPower Silicon
  - Batteries: 4.94kWh Li-Ion (20kg)
  - Motor: 1 Mitsubishi 2096D-II
  - Wheels: 4 GH Craft Composite 16"
  - Chassis: Carbon Fiber/Aluminum Honeycomb

Start a Team

Are you a current college student, faculty member, or proud alumn who would like to see your university competing in future events? Consider starting a solar car team to provide a great multi-disciplined experience for today’s students that will become tomorrow’s leaders. FSGP/AASC events are open to university/college teams from around the world. Contact us, talk with the current teams, and/or speak with any of our event staff to learn more about what is involved with the solar car project. Join these universities and more at the next event!
Santa Fe National Historic Trail

**American Solar Challenge Stops**

**Independence, MO | Independence Square**
August 3, 9:00 am
Once the location of frenzied outfitting activity throughout the mid-1800s, Independence was the jumping-off point for the Santa Fe and Oregon Trails and a starting point for the California Trail.

**Council Grove, KS | Council Grove High School**
August 3, 12:00 - 2:45 pm
For a brief period, Council Grove served as the last opportunity for Santa Fe Trail travelers headed west to pick up supplies for their journey.

**McPherson, KS | Midway Motors**
August 3, 2:00 - 6:00 pm
August 4, 10:00 am
The city of McPherson was founded in 1872, towards the end of the Trail’s use. In 1879 the railroad arrived in McPherson, effectively replacing the Santa Fe Trail.

**Dodge City, KS | CVB, Boot Hill Museum**
August 4, 12:45 - 4:30 pm
Near Dodge City the Trail split into two routes. The ASC is following the Mountain Route, the longer of the two.

**La Junta, CO | Bent’s Old Fort NHS**
August 4, 3:45 - 5:30 pm
August 5, 8:00 am - 3:15 pm
Between 1833 and 1849, Bent’s Old Fort attracted diverse groups of people to trade: white Americans, American Indians, Mexicans, Hispanics, and more.

**Las Vegas, NM | West Las Vegas High School**
August 6, 10:00 am - 6:00 pm
August 7, 9:00 am - 5:00 pm
Officially founded as Señora de Los Dolores de Las Vegas, Las Vegas was once the largest city in the Southwest and a key stop on the Santa Fe Trail.
A Challenge about more than just Engineering

For these teams, the challenge of the American Solar Challenge begins long before the solar cars hit the road. A solar car team effectively acts as a small business – attracting sponsors, managing public relations, developing and executing a project plan, and, yes, producing a solar car.

In addition to the design and build of the solar car, teams must also plan for the logistical challenges of traveling with a team for approximately 5 weeks – lodging, meals, support vehicles, safety equipment, and more. While most teams have engineers, you will also find majors in business, marketing, and other fields. The beyond-the-textbook, multi-disciplinary aspect of the solar car experience serves these students well as they prepare for their future careers across a range of industries.

What are the Optional Loops?

For 2021, the American Solar Challenge has been setup as a distance-based event to challenge teams with how many official miles they can complete over the 5-day, 3-stage event. The base distance is just under 1000 miles. For teams that have extra energy to burn, select locations offer the opportunity to drive optional loops. These loops allow those teams to get credit for the extra distance driven, demonstrating the additional capability of their solar powered vehicle. Teams are ranked on official distance and then by official elapsed time to complete that distance. The optional loops add a new element to the energy management strategy for the teams.

Below is a nominal schedule for a day on the road in the American Solar Challenge. Due to the staggered start, end of the day grace periods, and time zones adjustments, the exact schedule may deviate.

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 AM</td>
<td>Battery release and morning charging. Teams check over their solar cars, eat breakfast, and prepare for the day ahead.</td>
</tr>
<tr>
<td>9:00 AM</td>
<td>Start driving. At stage starts teams are released in 1-minute intervals. (10am local time start in McPherson)</td>
</tr>
<tr>
<td></td>
<td>The Next 9 Hours</td>
</tr>
<tr>
<td>Drive.</td>
<td>As needed. Stop to charge, fix a flat, or change drivers. There is no lunch break. Upon arrival at a Checkpoint (designated 45-minute stops), the team jumps out of the support vehicles and points the solar array towards the sun. The support vehicles may leave to get fuel or other supplies. Observers check in with the event staff, route updates are given, and the public has the opportunity to see the cars and meet the teams. After 45 minutes, the solar car can resume driving.</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>The driving day ends and evening charging time begins. Teams are given a 45-minute grace period to find a safe place to stop for the night if between stage points.</td>
</tr>
<tr>
<td>8:00 PM</td>
<td>Battery impound followed by time to work on the solar car (minus batteries), find lodging, check the weather forecast, and get ready for the next day.</td>
</tr>
</tbody>
</table>

A TYPICAL DAY ON THE ROAD

How do solar cars work?

Solar cars use photovoltaic cells to convert sunlight into energy. This energy powers an electric motor to make the car go or can be used to charge batteries to store energy for those not-so-sunny days.

Do the cars have air conditioning?

No. Though teams are required to provide driver ventilation, these vehicles are designed to maximize energy efficiency. Air conditioning, power windows, and other creature comforts would only consume electricity without improving the car’s performance.

Do teams pick the lightest driver?

All drivers are ballasted to 80kg for the event, so individual driver weight is not a primary factor. Efficient driving skill is more important.

Is the first team across the line the winner?

Not necessarily. The winner of the single-occupant vehicle class is determined based on the official mileage completed across all stages of the event, including optional loops and reduced for any penalties incurred. For the multi-occupant vehicle class, additional considerations of energy efficiency and factually practice into the overall score.

What about cloudy days?

Solar cars carry batteries that can be charged using the solar cells on the car. When facing clouds or needing extra power, the car uses stored energy. Hence, the solar cars can continue to drive in the clouds and rain, although likely at a slower speed to conserve energy.

How fast can the solar cars go?

Teams must obey posted speed limits, and regulations limit the cars to 65 mph for the event. During testing, some solar cars have reportedly reached speeds of 100+ mph.

Can I buy a solar car?

These solar cars are built specifically for competition. However, there are many EVs and plug-in hybrids that can be bought today and charged from home solar panels.

UNDERSTANDING THE 2 Classes of SOLAR VEHICLES

As mentioned earlier, teams are split into 2 classes based on the type of solar powered vehicles they have entered. The solar car is either in the single-occupant vehicle (SOV) class or the Multi-Occupant Vehicle (MOV) class.

<table>
<thead>
<tr>
<th>Single-Occupant Vehicles</th>
<th>Multi-Occupant Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seats 1 person</td>
<td>Seats 1 or more people</td>
</tr>
<tr>
<td>Smaller allowable solar array size</td>
<td>Larger allowable solar array size</td>
</tr>
<tr>
<td>Batteries are limited by weight</td>
<td>No limit on amount of batteries</td>
</tr>
<tr>
<td>No recharging via external sources (penalty would be incurred)</td>
<td>Recharging via external sources is allowed and energy metered</td>
</tr>
<tr>
<td>Scoring is based on the official distance completed, including any penalties incurred. Ties are determined by the lowest overall elapsed time.</td>
<td>Scoring is a combination of an energy efficiency score (people-distance, time, and external recharging) and a practically score.</td>
</tr>
</tbody>
</table>

FAQ

New in 2021!
From inspectors to stage/checkpoint crews to our route advance team and more, the officials perform a variety of roles during the event. Many are also involved in the preparations prior to the event, including reviewing the technical design reports, developing the route, and coordinating all of the logistics of the event.

Dan Bohachick
Brian Call
Tyler Coffey
Steven Day
Megan Derwich
Domenic DeVincenzi
Bill Elliott
Sue Eudaly
Kila Henry
Byron Hoppes
Ryan Hupp
Byron Izenbaard
Gail Luck
Marie McMullen
Steve McNutten
Senait Nuguse
Paul Park
Dale Reid
Jeremy Rogers
Dan Saulsbury
Stephanie Saulsbury
Kevin Smith
Nick Smith
Evan Stumpges

The Observers travel with the teams along the ASC route. Riding in the team’s chase vehicle, their role is to monitor the solar car’s progress, impound the batteries at night, and release them back to the teams in the morning. Observers get to experience firsthand the ingenuity and hospitality of the solar cars teams.

Ryan Babaei
Emily Bonita
Keenan Dungey
Kila Henry
Lucas Lombard
Jim Martin
Vikram Nath
Julie O’Mara
Gina Park
Allen Rues
Louise Werner

The role of the Jury is to resolve team disputes and rule on any penalty appeals during the event. Jury members include Dan Eberle (Chair), Paul Hirtz, Scott McBrean, Greg Thompson, and Osvaldo Betancourt, all with past solar car experience.

Planning has already begun for 2022. Stay tuned for announcements and consider how you can get involved:
• Participate as part of a university team
• Volunteer to help with the event
• Sponsor the event with your generous donation

Special Thanks
Thanks to those serving in other roles, including MOV Practicality Judges, Location Hosts, and more. Special thanks to our event partner, the National Park Service, as well as the Santa Fe Trail Association for their help in putting this event and route together.

Contact us at ascinfo@americansolarchallenge.org