#3 University of Kentucky
#4 Massachusetts Institute of Technology
#6 University of California, Berkeley
#9 Iowa State University
#17 Illinois State University
#22 University of Illinois at Urbana-Champaign
#30 Western Michigan University
#32 Principia College
#35 University of Minnesota, Twin Cities
#49 Georgia Institute of Technology
#99 North Carolina State University
#785 University of Kansas
#828 Appalachian State University

American Solar Challenge

Formula Sun

americansolarchallenge.org

Innovators Educational Foundation

1028 S Bishop Ave #314
Rolla, MO 65401
ief@americansolarchallenge.org

Innovators Educational Foundation (IEF) is a non-profit 501c3 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.

IEF Events

- American Solar Challenge
- Formula Sun Grand Prix
- IEF Solar Car Conference

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!

American Solar Challenge

Santa Fe Trail

2021

EVENT PARTNER

Santa Fe Trail
1821 200 YEARS 2021

TRACK PARTNER

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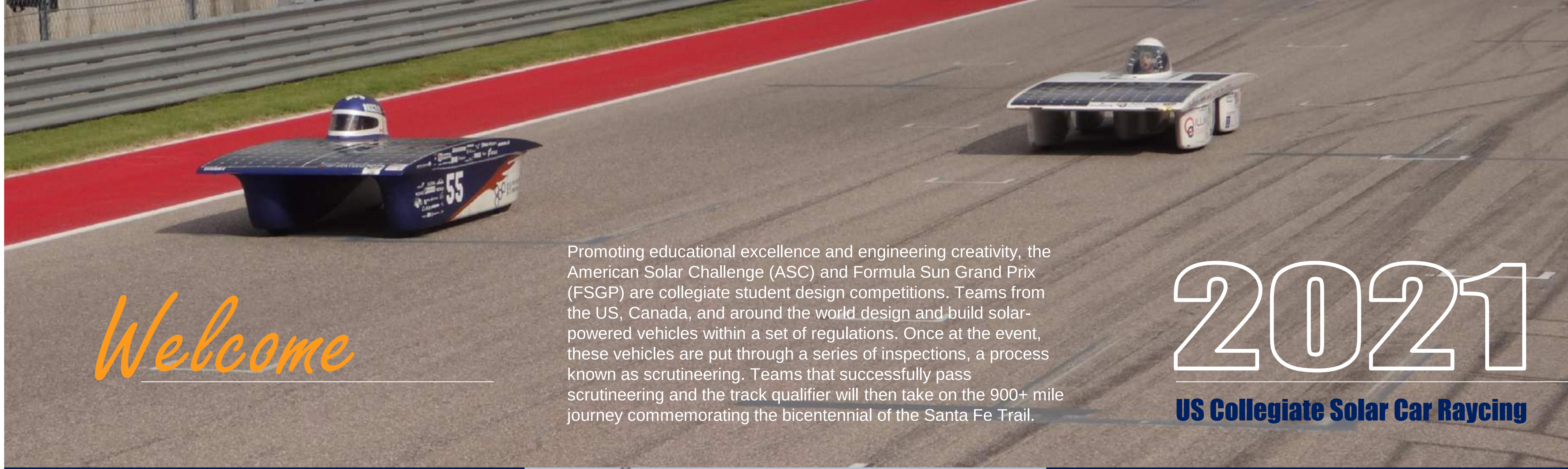


Welcome

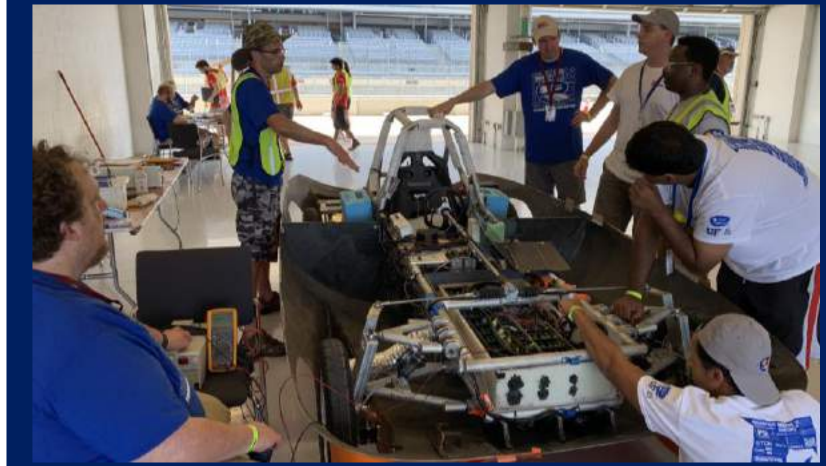
Promoting educational excellence and engineering creativity, the American Solar Challenge (ASC) and Formula Sun Grand Prix (FSGP) are collegiate student design competitions. Teams from the US, Canada, and around the world design and build solar-powered vehicles within a set of regulations. Once at the 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.

2021

US Collegiate Solar Car Raycing

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 all 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)


FSGP 2019 Team Photo

Iowa State University
#9 Eliana

- **L x W x H:** 4.98m x 1.12m x 2.10m
- **Weight:** 415kg
- **Array:** 1283W SunPower Si/Spectrolab GaAs
- **Batteries:** 16.9kWh Li-Ion (71.2kg)
- **Motor:** 2 Mitsuba M2096-III
- **Wheels:** 4 Bridgestone Ecopia 16”
- **Chassis:** Carbon Fiber Semi-monocoque

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 Mitsuba
- **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:** 5.22kWh Li-Ion (20kg)
- **Motor:** 1 Mitsuba
- **Wheels:** 4 GH Craft Carbon Fiber 16”
- **Chassis:** Semi-Monocoque Carbon Fiber Panel

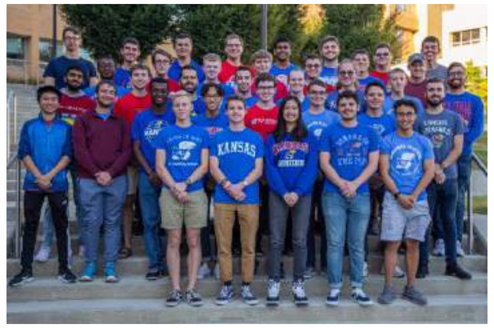
Georgia Institute of Technology
#49 Endurance

- **L x W x H:** 5.00m x 1.25m x 1.20m
- **Weight:** 200kg
- **Array:** 895W SunPower Silicon
- **Batteries:** 4.7kWh Li-Ion (20kg)
- **Motor:** 2 Marand
- **Wheels:** 4 GH Craft Carbonfiber 16”
- **Chassis:** Aluminum Tubular Space Frame

NC State
#99 SPX

- **L x W x H:** 4.15m x 1.74m x 1.44m
- **Weight:** 1212kg
- **Array:** 600W SunPower Silicon
- **Batteries:** 26kWh Lithium Titanate (280kg)
- **Motor:** 1 Emrax 228
- **Wheels:** 4 BMW i3 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:** 1000W SunPower Silicon
- **Batteries:** 5kWh Li-Ion (20kg)
- **Motor:** 1 QS Motor
- **Wheels:** 4 CST17 16”
- **Chassis:** Chromoly Steel Tube Frame

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 Mitsuba 2096D3
- **Wheels:** 4 Aluminum 16”
- **Chassis:** Aluminum Honeycomb/Fiberglass Skins

MIT
#4 Nimbus

- **L x W x H:** 4.06m x 1.60m x 1.02m
- **Weight:** 183kg
- **Array:** 987W SunPower Silicon
- **Batteries:** 4.94kWh Li-Ion (20kg)
- **Motor:** 1 Mitsuba 2096D-II
- **Wheels:** 4 GH Craft Composite 16”
- **Chassis:** Carbon Fiber/Aluminum Honeycomb

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 Mitsuba M 1096-III
- **Wheels:** 4 GH Craft CFW-S16-94B 16”
- **Chassis:** Aluminum Spaceframe

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 (20kg)
- **Motor:** 1 Marand
- **Wheels:** 4 Moped 16”
- **Chassis:** Carbon Fiber/Kevlar Composite

Principia College
#32 RA XI

- **L x W x H:** 3.90m x 1.80m x 1.07m
- **Weight:** 170kg
- **Array:** 800W SunPower Silicon
- **Batteries:** 4kWh Lithium Polymer (20kg)
- **Motor:** 2 Mitsuba
- **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 (85kg)
- **Motor:** 2 Custom In-house
- **Wheels:** 4 6061-T6 aluminum 22”
- **Chassis:** Carbon Fiber Monocoque

Appalachian State University
#828 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 Mitsuba 2096-D3
- **Wheels:** 4 7075 Aluminum 16”
- **Chassis:** Carbon Fiber Sandwich

Start a Team

Are you a current college student, faculty member, or proud alum 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/ASC 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

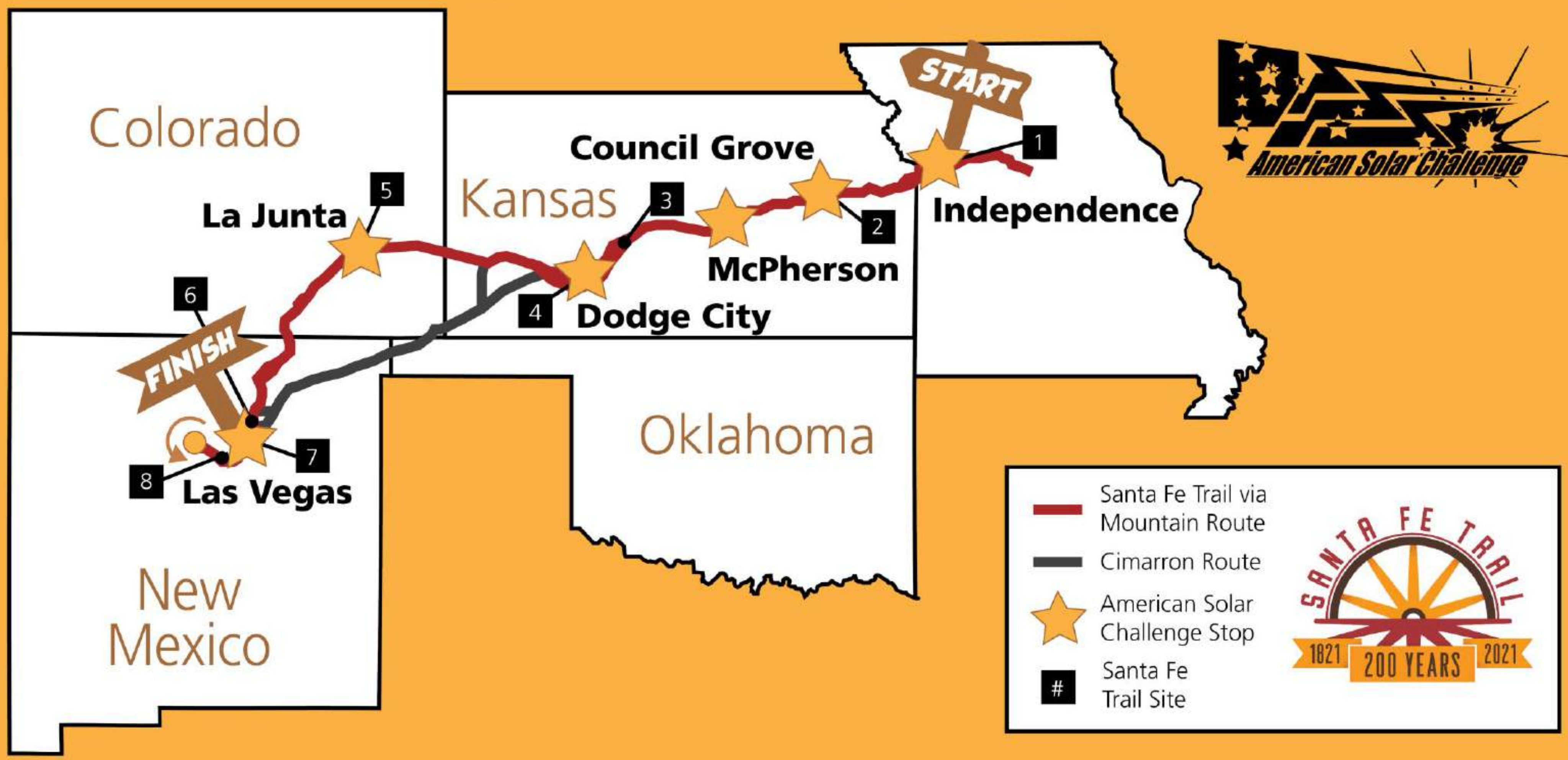
@SantaFeTrailNPS
@NTIRNPS
www.nps.gov/safe


7 Las Vegas Plaza


5 Bent's Old Fort National Historic Site


3 Fort Larned National Historic Site


1 Independence Courthouse




8 Pecos National Historic Park


6 Fort Union National Monument


4 Santa Fe Trail Tracks


2 Neosho River Crossing

Download the NPS App from the App Store and Google Play!

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.

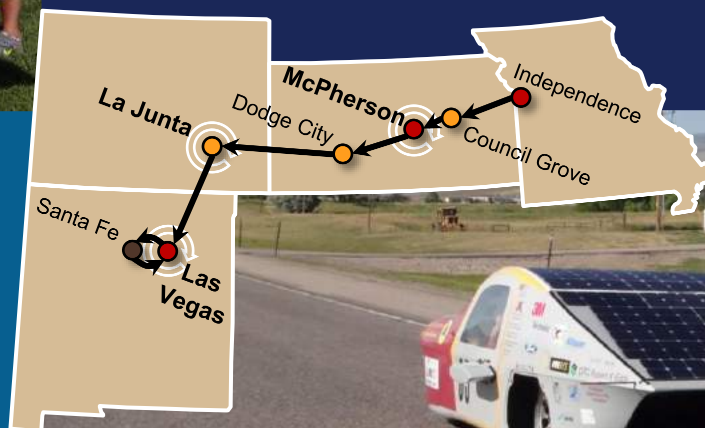
La Junta, CO | Bent's Old Fort NHS
August 4, 3:45 - 5:30 pm
August 5, 8:00 am - 3:15 pm
Between 1833 and 1849, Bent's Old Fort attracted diverse groups of people to trade: white Americans, American Indians, Mexicans, Hispanos, and more.

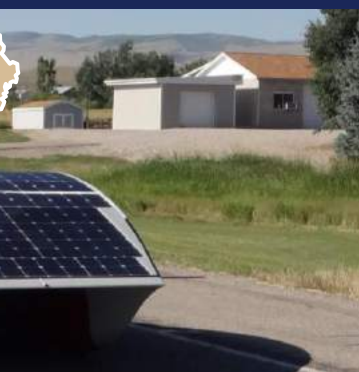
Las Vegas, NM | West Las Vegas High School
August 6, 10:00 am - 6:00 pm
August 7, 9:00 am - 5:00 pm
Officially founded as Señora de Los Dolores de Las Vegas, Las Vegas was once the largest city in the Southwest and a key stop on the Santa Fe Trail.

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.

New in 2021!





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 2 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.

A TYPICAL DAY ON THE ROAD

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.

7:00 AM	**Battery release and morning charging.** Teams check over their solar cars, eat breakfast, and prepare for the day ahead.
9:00 AM	**Start driving.** At stage starts teams are released in 1-minute intervals. *(10am local time start in McPherson)*
The Next 9 Hours	**Drive.** 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.
6:00 PM	**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.
8:00 PM	**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.

FAQ

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 practicality factor into the overall score.

Why do solar cars look so different?

Conventional passenger cars typically use more energy overcoming air resistance, known as aerodynamic drag. Solar cars are designed to minimize the energy lost due to drag, resulting in unique shapes and lightweight designs. Many solar cars include fairings around the wheels to further improve aerodynamics.

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.

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 this stored energy. Hence, the solar cars can continue to drive in the clouds and rain, although likely at a slower speed to conserve energy.

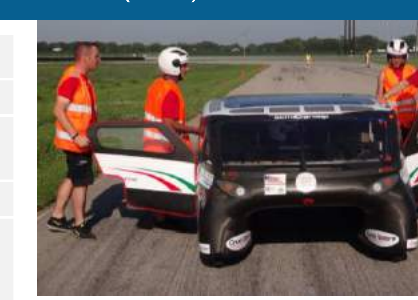
Can I buy a solar car?

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.

Single-Occupant Vehicles	Multi-Occupant Vehicles
• Seats 1 person	• Seats 2 or more people
• Smaller allowable solar array size	• Larger allowable solar array size
• Batteries are limited by weight	• No limit on amount of batteries
• No recharging via external sources (penalty would be incurred)	• Recharging via external sources is allowed and energy metered
• Scoring is based on the official distance completed, including any penalties incurred. Ties are determined by the lowest overall elapsed time.	• Scoring is a combination of an energy efficiency score (people-distance, time, and external recharging) and a practicality score.



Wilson Cup Travels

The Wilson Cup is the traveling trophy for the American Solar Challenge. For the past 3 years, the winners of the American Solar Challenge 2018 have shared the trophy. Pictured here, Western Sydney University from Australia, first place in the SOV class, hands the trophy off to the University of Bologna from Italy, first place in the MOV class. The Wilson Cup has literally made its way around the world and is ready to be awarded to the winners of the American Solar Challenge 2021.

On the upper base, the five bands recognize the winners of the five Sunrayce events throughout the 1990s. The lower base recognizes American Solar Challenge winners since 2001.

1990 to Today...

The American Solar Challenge began in 1990 as Sunrayce, with subsequent events occurring every 2-3 years, featuring different routes and challenges for the teams. The Formula Sun Grand Prix was introduced in 2000 to provide an annual track event. In 2001, the road event was rebranded to the American Solar Challenge, recognizing the event's location.

...and Beyond

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

Contact us at ascinfo@americansolarchallenge.org

Thank You!

These events would not be possible without the time and dedication of our volunteers before, during, and after the event! We appreciate this team for their contribution to the solar car community.

Event Staff & Inspectors

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	Kila Henry	Paul Park
Brian Call	Byron Hopps	Dale Reid
Tyler Coffey	Ryan Hupp	Jeffrey Rogers
Steven Day	Byron Izenbaard	Dan Saulsberry
Megan Derwich	Gail Lueck	Stephanie Saulsberry
Domenic DeVincenzi	Marie McMullen	Kevin Smith
Bill Elliott	Steve McMullen	Nick Smith
Sue Eudaly	Senait Nuguse	Evan Stumpges

Observers

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 first-hand the ingenuity and hospitality of the solar cars teams.

Ryan Babaie	Lucas Lombard	Julie O'Mara
Emily Bonifas	Jim Martin	Gina Park
Keenan Dungey	Vikram Nath	Allen Rues
Kila Henry		Louise Werner

Jury

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 McBroom, Greg Thompson, and Osvaldo Zorzano Betancourt, all with past solar car experience.

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.