

evGrand Prix Kart Manual

Teacher Guide



PURDUE
UNIVERSITY
MOTORSPORTS

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Introduction and Purpose

It was the general idea of this guide to try and help new teachers and districts to have a successful first year and a guide for maintaining and growing their electric vehicle (ev) karting program. Here we will give schools and teams an overview of what is necessary for you to make a decision about participation and clearly understand what is required for success. We will cover important 1st year topics and possible directions for your program to go in the future. You will find that the academic competitions are interesting and required at all level of competition (High School through Collegiate). Kart building on the other hand is a bit more of a lesson for all the first time thru. This should be helpful as you charge ahead with a true “hands on” STEM experience that they will cherish for a lifetime. Racing at the Indy 500!

The electric karting program will assist students with learning science content standards, developing engineering and technical skills, project management, sales and marketing, design, fabrication, team work/building and outreach into their local community. Many of the items in the karting program fit well as relevant props for math, language arts, communications, business and even social studies problems that students just cannot seem to get their hands around in the class room. College bound or not, this is one program that will give students a hand up with hands on!

The culminating event, which is held at the Indianapolis Motor Speedway, is a day to remember! The University and Collegiate Students, racing on the same track but a different day, will all use the same pit and garage area to finalize their karts. This allows for coaching and mentoring from the collegiate teams on a very fundamental level. This interaction helps clearly demonstrates to high school students how the collegiate teams are using their coursework to study real world problems, innovating, and developing solutions to tomorrows problems, today.

Planning

Your school and district needs to decide how you are going to run your program. There are several options that can be taken. Please do not limit yourself to only the suggestions below. As groups take time to think outside the box and develop a plan that will work for their school corporation real learning opportunities take place. Below are two suggestions of what has been success by other districts.

1. Integrate into a specific course of study. Make your program part of a class that meets on a regular basis. ICP, Engineering, Transportation, etc., the class options are endless. Be creative and think what is best for your school and community. To be a successful program you will need to look at subject areas including marketing, technical documentation, graphic design, engineering design, fabrication, manufacturing, logistics, data collection, and physical science. These can be taught as a single class or within multiple classes. Decide as a district what is best for you.
2. Integrate into a club. This program can meet as an after school club. Decide when to meet and how often to accomplish what it will take to be a successful program.

Organizing and Gathering Interest

As a first year participant in the program you will need to find a group of students who will join you if your program is an after school club. If your program is to be part of an existing course you need to determine how you will integrate the program into existing coursework. As you organize your team, look for those who excel in the areas of marketing, technical documentation, graphic design, engineering

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design, fabrication, manufacturing, logistics, data collection, and physical science. Teams will need students strong in language and communication along with students who excel in engineering and hands on building. These students will need to work together to accomplish the goal of building an electric kart and preparing for the events throughout the year. Ideally, each team should consist of 15 to 20 students involved with the 4 major focuses of the program; community outreach, design and engineering, energy efficiency, and racing. At a minimum your team will require 5 students; driver, crew chief and 3 crew members.

Financial Support

Your first year of the program will be your most expensive year. A new kit will cost in excess of \$5,000 (for complete lists of major costs see purchasing guide). The cost can drop if you decide to find used components or do some of the fabrication yourself. After the first year your school will only need to maintain the karts (see funding year to year). This might include buying new batteries, motors, tires, fixing damage caused during racing, etc.

To obtain the funds most schools are relying on local business sponsors. The students develop a plan to reach out to businesses to seek financial or in-kind donations. To help with this process many teams/schools take advantage of websites, social media, and other methods to promote their program. It is helpful to develop marketing strategies to send to potential sponsors that will inform them of your school and program.

Purchasing the Kart

Today teams can purchase their entire kit from Top Kart USA. After reviewing the purchasing guide, your district needs to decide which options you will be pursuing. There are many factors that need to go into this decision. Take into account the space that you have to work in, along with the equipment available. Look into the resources that your staff can provide along with your community partners. Besides your resources consider the amount of time that your students will be able to work on the kart. Make sure you are choosing an option that will bring success to your program.

Championship Series

The series will consist of two races, IMS in the spring and Purdue in the fall. The spring IMS race will be the World Championships held at the Indianapolis Motor Speedway in May. This race will include teams from across the US and the UK. Driver training, “lap time” and “Test and Tune” events will be located at tracks around the state prior to Race Events. Besides the race event itself, teams will compete in an academic challenge incorporated into the series. Race results and the results from the academic challenge will be used to determine the top teams.

Academic Competition

The evGrand Prix competition is designed for learning not just racing. While the racing may be “cool” the learning is exceptional. Though driver skill and a fast kart may win a race, to win the Championship Series will take many different students working together as a team in the same way they would in a race team. The Championship Series will be decided based on the categories listed below. Rubrics and detailed explanations of the categories are available online and within the Academic Challenge Rule Book.

Community Outreach: The community outreach competition is one where the students will go into the community to promote their High School evKarting Program and STEM education. Your school can bring the community in to the school, appear at teacher conferences, attend local events in your community and reach out on social media to let people know about your MSTEM³ program. Make sure you document everything students do in this category: number of events, number of attendees, social media followers, etc. Teams are then asked to put all their efforts together into a cool presentation for judging at the world finals at IMS.

This is all about communication, how your team reached out to the community. Each team presentation score will be based on individual outreach opportunities, marketing, and community impact, team work, leadership and soft skills. The rubric for community outreach is provided on the evGrand Prix website. Teams will have their score for this section prior to the official IMS race and will account for 20% of the teams overall score for the Championship Series.

Design Review: This is the part of the competition that will require students to take on the role of engineer and technician specialist. This will require a presentation of a different nature. This is one where the lead engineering or technology skilled student will present the design concept of their kart, how it works and what sets their schools kart apart from the rest of the field. Teams must utilize detailed technical drawings, data collected, analysis results and mechanical knowledge to be competitive. There are several free options for schools needing CAD software.

This category assures that teams will have to be creative, knowledgeable of electric vehicles and also know how to communicate to a group of professionals. Imagine your team trying to convince a Formula 1 team of their latest idea and why it will make a Formula 1 car go faster.

Each team presentation score will be based on their team's over kart set-up, kart mechanics, electronics and safety protocols. The rubric for design review is provided on the evGrand Prix website. Teams will have their score for this section prior to the official IMS race and will account for 20% of the teams overall score for the Championship Series.

Energy Efficiency: This competition is very engineering based and requires a bit of testing on track (and on a dynamometer if available) to see if you have it correct. The idea is to complete 80% of the race laps in the shortest amount of time, while using the least amount of energy to do so. Many factors come into play including gear ratios, kart set up, tires size/pressure and the driver ability of course. Energy will be measured before and after the race thru a Power and Energy Monitor (PEM) system used by race timing and scoring officials.

Each team kart will be evaluated based on the overall energy usage from the spring IMS Race. Teams must complete 80% of race laps to receive points in this category. Teams will have your score for this section shortly after passing through post-race tech inspection, immediately following the race, and will account for 20% of the teams overall score for the Championship Series.

Race Results: This category is based on your placement in the evGrand Prix World Finals race held at the Indianapolis Motor Speedway in May. The High School evGrand Prix World Finals Race event will consist of a minimum of 20 laps. Under no circumstances will the race be made longer than can be completed with the specified total kWh of battery energy available to each team. Race placement will be based on number of laps completed and overall standing. This will account for 40% of the teams overall score for the Championship Series.

Championship Winner: The winner will be the school/team that scores the most points according to the guidelines set out in the Academic Challenge rule book and above. This will be decided at the end of the evGrand Prix World Finals held at the Indianapolis Motor Speedway in May.

Trophies will be awarded to the top community outreach team presentation, top Design and engineering team presentation, team with the highest energy efficiency, top 3 race finishers and the overall Championship Series winner.

How To Be Successful

The first thing to remember is teams are not expected to compete in this program in isolation. Our goal is to create a network of support for all schools. Do not be afraid to reach out to community partners, past teachers, or local professionals for advice. Be sure to take advantage of the following resources available to teams and schools throughout the year:

evGrand Prix Staff: Purdue University has hired Stuart White as a resource for all high school teams involved in the program. Stuart has been with the high school program from its beginning. His job is to provide you with the curriculum, program materials and communications, as well as technical service and support you need to be successful. Feel free to contact him for help (contact information below).

Purdue Outreach: Another option is the Purdue Extension Offices around the State. They will be available to assist in most of the urban and extreme rural communities.

Teacher Input: Teacher input is one of the best methods of growing a program. Great communication between the teachers, coaches/mentors and our MSTEM3 academic team will make things progress at a much higher rate. A list of the previous year's teams, with contact information, is available online.

Teacher Coaches: There are a number very valuable High School Teachers that were in the early pilot program and are willing to lend a hand with some guidance and to help you get through those difficult times. They see the value of the program and what it has done for their students. They are great consultants and coaches. A list of Mentor Coaches, with contact information, is available online.

Workshops: There will be workshops and events throughout the school year. Workshops will give teams and coaches the chance to get answers to their questions on kart assembly, wiring and kart setup. "Karting experts" will be on hand at the workshops to help teams understand how to assemble their karts and balance the seat, install electrical components and wiring, and tune the your kart when testing. There will be breakout sessions on how to establish a testing log book, collecting and analyzing data, and how to use the data collected.

Coaches and Mentors: There are coaches and mentors available in most communities. In some areas our Municipal Firefighters have stepped forward and agreed to coach a few after school teams. It takes a village and these Firefighters are an example role model in the urban school district and serve in that capacity as well. With the correct Coach and structure, after school programs can work effectively. However, the academic advantage cannot be fully recognized in the after school application without a skilled high school teacher. In many rural communities it could be the local car dealership mechanic and a farmer who are the coaches for the team. It all works.

Karting Build Manual

Each team will be supplied with a complete kart build manual. Please refer to the manual for all questions regarding the assembly of the kart. If you are having difficulties, please contact Stuart White

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for further assistance.

Today teams can purchase an entire kit from Top Kart, making building your team's kart a straight forward process. The manual is designed to give instructions on assembling an electric go kart, in general, and not be a step by step instruction manual. As such, teams can use it as a reference for what components make up the electric kart and how those parts are incorporated into a final product. This manual is a "living document" and updated as time, technology, and experience dictates. This will improve communication and program development as the program grows and progresses.

Motorsport Safety

Motorsports safety is always our first concern. Safety is the most important mission of all motorsports. An Indy Car can safely run down a straight away at 240mph and a Top Fuel Dragster can exceed 300mph, both doing so safely. We may not reach those speeds, however we are racing these karts at high rates of speed and that is exactly why safety is so important. We would not have this program today if it were not for strong safety programs in Indy Car, NHRA and WKA (World Karting Association).

NFPA 610 Compliant: All race and testing activities will be NFPA 610 compliant and enforced at all times. Training and implementation is all of our responsibilities. Keeping our students safe is the highest of priorities. A great safety system assures that.

Practice and Testing: Any operation of the racing kart outside of a sanctioned track is strongly discouraged. It is highly recommended that you utilize a designed race course or one set up with Purdue or WKA supervision and oversight.

Indoor Tracks for Practice and possible Winter Months Race: We are working on developing a relationship with Indoor Karting Facilities to utilize their course during the colder winter months for providing "lap time" and evkart Test and Tune events.

Contact any of the following with your questions:

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Websites:

www.evgrandprix.org – Provides information on evGrand Prix events, documents, resources, registration and staff contact.

www.purdue.edu/mstem3 - Provides information on MSTEM³ classroom curriculum and teacher resources.

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