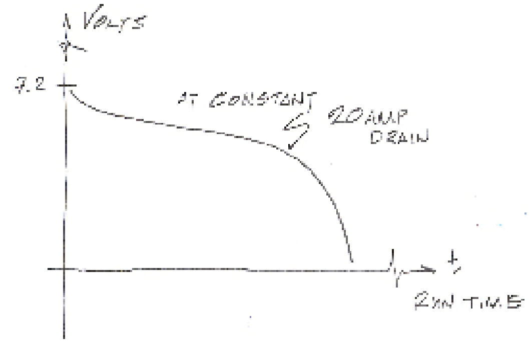
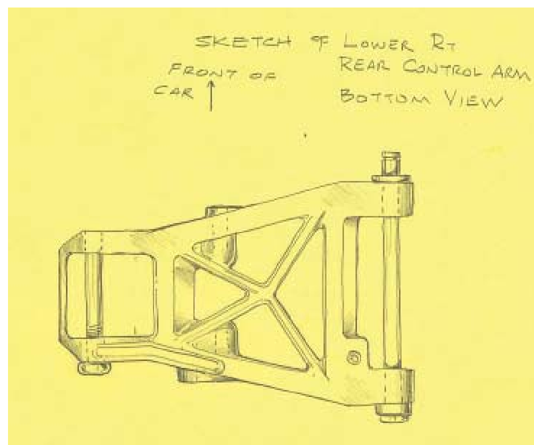
FastTrack RC Curriculum Context

Engineering Performance

The ultimate challenge for a FastTrack RC team is to engineer performance. How you tackle the challenge depends on your definition of performance. For race engineers and FastTrack RC (FTRC) Teams, it is to win races by designing an efficient car with exceptional cornering speeds, very low drag and the proper set up for track conditions. For a math teacher, it may be to see students apply a 2nd order equation to a data set (without prompting). Policy makers may want students to understand energy efficiency and real options for Petroleum Independent Transportation (PIT Now!).



Performance in the FTRC means going further, faster. Going both far and fast is a matter of energy efficiency because the finite amount of energy in a battery supplies a finite amount of force. How much of that goes to forward motion depends on the car design and setup. FTRC students improve the design, engineer the right set up and (optional) setup a renewable energy charging station.



The formal FTRC curriculum is set up in modules with suggested project sequences and schedules to meet a variety of educational goals. For example, if your goal is to introduce design through 3D CAD in 6 weeks, you may focus on improving the lower control arm or chassis underplate. If you have a year-long STEM course or club, your students can divide into teams, tackle almost every project and be competitive in the FTRC Points Race.

As you design your program, keep in mind two different team models that both have high performance histories.

1. Hendrick Motorsports: All 4 Cup teams work together by sharing data and ideas in the race shop; however, it is each team for itself once the hauler heads for the track. They collaborate and compete.

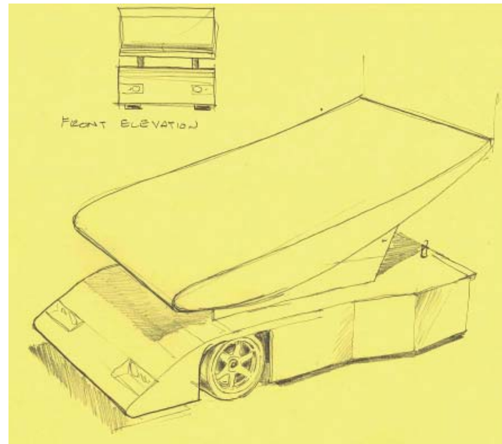
2. Roush Fenway Racing: 5 'Roush' Cup teams consider themselves competitors whether in the wind tunnel, race shop or track. There is no collaboration, only competition.

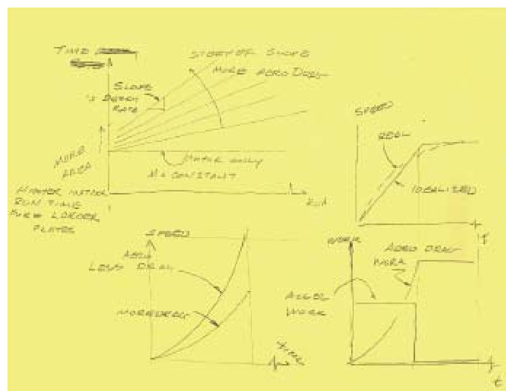
Groups of 2 - 4 students can work on different projects then share designs and data (Hendrick model) ... or not share (Rousch model).

Contact your Ten80 Team Member to learn about turn-key summer camp programs.

Engineering Perspective

A good engineer is a broadly experienced engineer who has a library of images, ideas and historical solutions to draw from when facing a challenge. As learners you probably don't have a brain full of SUCCESSFUL IDEAS, but hopefully you have a brain full of CREATIVE ones. With literature searches, creative ideas can become testable ideas. Once tested, they will become part of your own internal library of solutions (or disasters to avoid).





Another advantage an engineer has that a student won't have is higher math. Math is the language of science. Math gives you X-ray vision so you can see inside things and understand how they do or don't work. The FastTrack RC curriculum handles math generally in 1 of 3 ways.

1. A lot of mathematics is hidden inside suggested designs and tools like SolidWorks. It is done for you.
2. With guidance on how to apply it, you're expected to do grade-level appropriate math.
3. Realistically, trial-and-model will replace some of the higher level mathematics. Where an engineer would sit with a graphing calculator or spreadsheet, students will investigate empirically (systematically try things).

Where to Begin...and Never End

A technician who contaminates samples makes it impossible for the chemist to reach conclusions about what works. Similarly a driver who can't drive consistently makes it impossible for engineers to figure out what works.

Once a driver can give 'good data' on handling and performance, the engineering team has an endless number of options for setting up and modifying the car. Based on the experience of thousands of professionals and billions of dollars, this curriculum guides FastTrack RC teams through the best ways to improve performance. There is no end to the adjustments and improvements; that's part of the fun.

Speak the Language of Math

Being able to describe relationships between variables can help when talking about STEM, politics, social trends, business and sports. Understand these four relationships and you can discuss most relationships you'll encounter professionally. Use your finger to draw a graph in the air for each one. Discuss examples for each one in the world around you.

- Linear: As one increases the other increases or decreases proportionally. F = ma is the perfect example. As the mass (m) increases, the Force (F) increases. Acceleration (a) is the slope of the line.
- 2nd Order (Quadratic Function): As one increases the other increases or decreases, hits a maximum or minimum then turns around. This is often called the 'Goldilocks Equation' because it describes the value that is 'just right'.
- 3rd Order (Cubic Function): Two local maxima and/or minimum points meaning there are two turn around points.
- Exponential: If the independent variable, X, appears as an exponent then the relationship is exponential. The following is an exponential relationship: $y = 3 * 6^{2x}$. The following is NOT an exponential relationship: $y = 3 * (2x)^6$. Exponential relationships are everywhere. Populations tend to grow exponentially. When an object cools (like a pot of soup) the temperature decreases exponentially toward the ambient temperature. Radioactive substances decay exponentially. Money accumulating in a bank at a fixed rate of interest increases exponentially.

FTRC Curriculum

Going further, faster can boil down to two types of projects: (1) Set-up adjustments or optimization and (2) modifications or design. Set-up means you are choosing the right setting or type for an existing part. Modification means you're changing the part design or building a new one altogether.

All of these FTRC design and optimization problems improve energy efficiency, but how will you get that energy? The FTRC cars are fueled by electrical energy that can come from conventional power plants (plug into the wall), solar, bio or wind energy. The PIT Now! book guides you over a major hurdle in the real problem of creating Petroleum Independent Transportation: establishing refueling sites.

There are over 14 million ways to *set up* the FTRC car that comes in your kit. A "set up" is the combination of gear set, spring settings, camber, toe angles, etc. and which one you need depends on track layout, conditions and definition of winning. The Pit Crew Log Book helps students solve the 'set up' problem by introducing concepts, investigating and creating math models.

There are an infinite number of ways you can *modify* the car to improve speed, handling and energy efficiency. If you sketched a concept car, it probably wouldn't look like the stock car you received. It might be sleek for low drag like full-sized electric cars. It might have an upside-down wing to add down force like a Sprint or Formula 1 car. The Aerodynamic Design book guides you through designing & engineering your concept car body using SolidWorks and COSMOS FloWorks, a virtual wind tunnel.

How will you connect your new car body to the car? You can use the same upper-chassis posts the stock body uses, but you'll lose a lot of the hard-won down force as it travels through the spring/shock system. What if you connected your new body directly to the lower control arm? The design aspects aren't simple, but this project from the Mechanical Design & Fabrication book could save a lot of energy bypassing the spring/shock system.

Speaking of the lower control arm, it could be greatly improved. For such a critical part in transferring energy, it has a low strength to weight ratio and is NOT aerodynamic. The same can be said for the chassis plate it connects to.

A curriculum specifically for middle grades is provided in the FTRC for Middle Grades booklet.

Reinforce and extend core, standards-based concepts from FTRC projects with lessons from the Math and Science on the FastTrack books.