Koenigsegg

FROM THE FIELD TO THE FAST LANE

Tustin, CA
Legacy Magnet Academy
Team 393C
By: Liv Kong

CHOOSING KOENIGSEGG

The engineering of ultra rare supercars fascinate me and what better company to choose than the one that makes the fastest in the world.

Koenigsegg luxury supercars sell for up to $5,000,000 and holds the world record speed of 330 mph.

As an aspiring engineer, I am in awe that Koenigsegg combines so much speed and power into a lightweight carbon fiber body while simultaneously meeting road safety requirements. When studying the company, I observed many interesting parallels to VEX. This excited me as I realized that something seemingly small like being on your high school robotics team could be scaled up to something as big as creating revolutionary supercars.

My journey started when I reached out to Daniel Kang, an Instagram-famous supercar collector. I toured his office to talk about, look at, and even ride inside a Koenigsegg. Through the power of networking and alliances (valuable skills learned from VEX), I met Niklas Lilja - Lead Test Driver at Koenigsegg. I learned more about Koenigsegg's Design Process and was given multiple resources to help construct this project.

My First Time Seeing
A $4.5 Million Car

Koenigsegg Agera
(Final Edition)

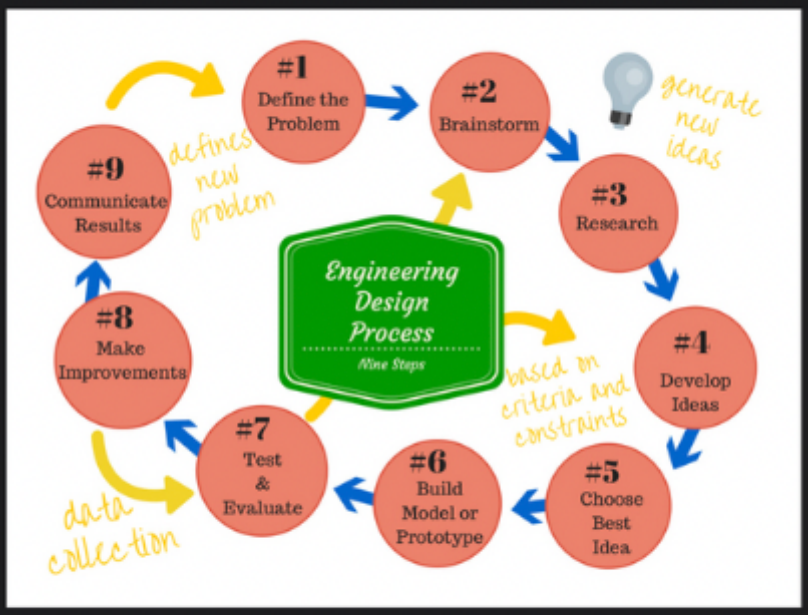
Triplex Suspension System

THE DESIGN PROCESS

A design process is a structured series of steps that can be followed to create a product or reach a milestone. This process helps ensure that decisions are thoughtful and purposeful.

At Koenigsegg, their design process is outlined into six essential steps. Our team, meanwhile, follows a 9-step engineering design process that serves as a structured framework to conceive ideas, build prototypes, and iterate solutions.

Niklas Lilja @ Koenigsegg
(Angelholm, Sweden)



Team 393C - Design Process

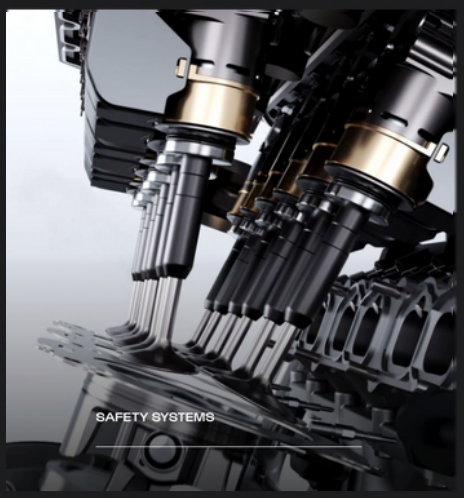
STEP 1 - DEFINE

Koenisegg's mission is to build the greatest supercar in the world with no compromise, no limits, and no fear of failure. Their mantra is to "innovate the future in-house" with the following defined purposes:

MUST BE THE WORLD'S **FASTEST** SPORTS CAR

MUST BE AERODYNAMIC

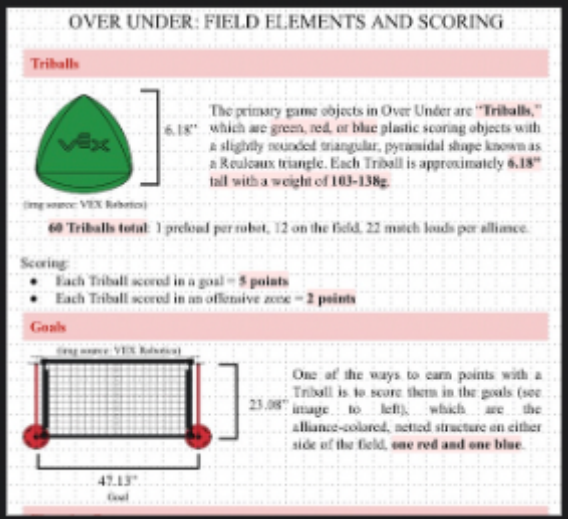
MUST BE ROAD LEGAL



Our team takes a similar approach by defining the mission and rules of our game, Over Under, then creates a Criteria & Constraints table to help build a robot that combines modular functionality and efficiency.

CRITERIA (Must be…)	CONSTRAINTS

Scoring/Match Criteria
• Able to score high amount of points consistently
• A good Alliance partner
 	
Build Criteria (must be…)
• High-speed robot
• Robust and durable
• Balance torque and speed
• Well-built
• Able to withstand force from other robots
 	
Robot Skills Criteria
• Able to do Driver Skills and Autonomous Skills
• Able to score only using their bot
	Scoring/Match Constraints
	• SCORING TRIBALLS is hard because net size
	• 2 minutes to score
	  ○ 15 seconds for auton
	  ○ 1:45 for driver control
	
	Build Constraints
	• Robot must be 18x18x18 inches
	• Limited time
	• Limited school parts
	• Limited money to buy parts
	• Pneumatic pressure limit - 100 PSI
	• 88 watts maximum
	
	Robot Skills Constraints
	• Limited time during skills (one minute)


OVER UNDER: FIELD ELEMENTS AND SCORING

Triballs

6.18"

The primary game objects in Over Under are "Triballs," which are green, red, or blue plastic scoring objects with a slightly rounded triangular, pyramidal shape known as a Reuleaux triangle. Each Triball is approximately **6.18"** tall with a weight of **103-138g**.

(img source: VEX Robotics)

60 Triballs total: 1 preload per robot, 12 on the field, 22 match loads per alliance.

Scoring:

- Each Triball scored in a goal = **5 points**
- Each Triball scored in an offensive zone = **2 points**

Goals

(img source: VEX Robotics)

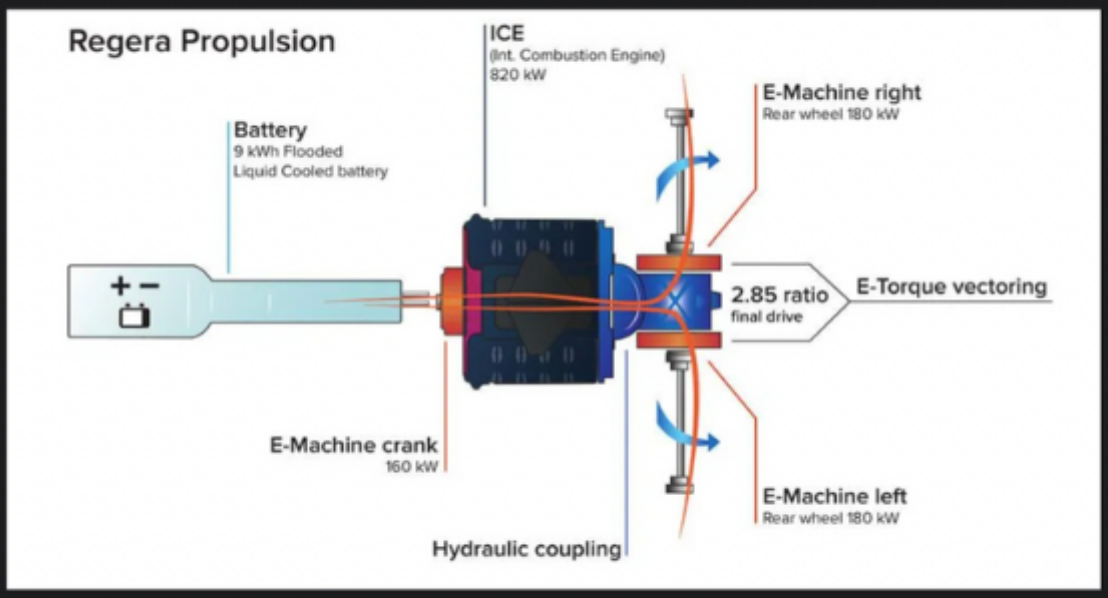
23.08"

47.13"
Goal

One of the ways to earn points with a Triball is to score them in the goals (see image to left), which are the alliance-colored, netted structure on either side of the field, **one red and one blue**.

STEP 2 - IDEATE

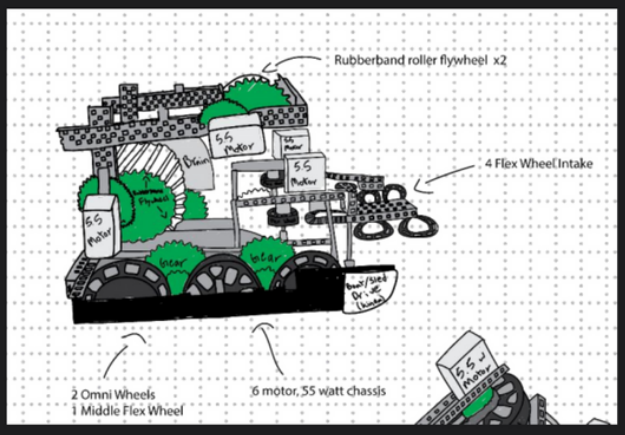
Koenigsegg describes this phase as an “embryo - the idea.” Brainstorming helps Koenigsegg challenge norms and explore unconventional ways to achieve their goals. For example, their engineering team collectively ideated a groundbreaking solution that integrated electrical motors into the gearbox, eliminating the need for a traditional clutch and flywheel.



Koeniggsegg Regera - Innovative Propulsion System

We emphasize brainstorming to enhance robot design for optimal performance. Similar to Koenigsegg, we sketch designs digitally to forecast what’s possible.

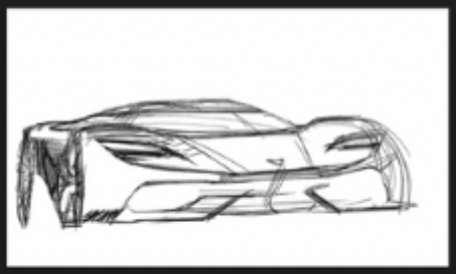
This shared focus on ideation and brainstorming is pivotal in creating both competitive robots and innovative supercars.



Team 393C Robot -
Digital Brainstorm Sketch

STEP 3 - CONCEPT & DESIGN

In the concepting phase, Koenigsegg CAD engineers produce intricate digital renderings serving as blueprints for their future designs. CAD plays an important role in translating visionary ideas into detailed 3D models, enabling Koenigsegg to fine-tune every aspect of their cars, from structural components to aerodynamic efficiency.



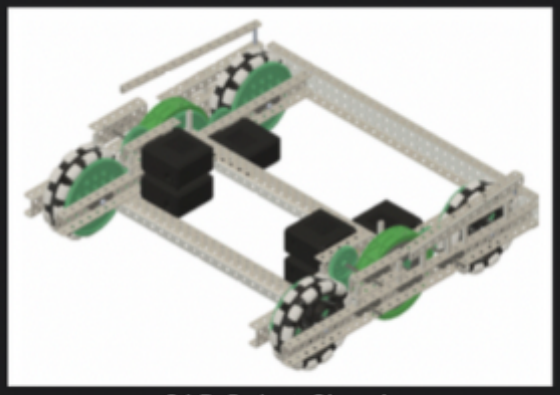
Digital Rendering

CAD 3D Model

Similar to Koenigsegg's use of CAD, we use a decision matrix to ensure our subsystems meet specific criteria while aiming for optimal performance. We then CAD our robot to finalize the complete design for seamless integration.

Idea	Ease of Build (5)	Efficiency (8)	Scoring Potential (5)	Durability (7)	Total	Total (w/o Ease of Build)
Design 1: • 11 w - 4 motor drive @ 300 RPM + 4 omni wheels and 2 traction wheels • 11 w- 1 motor endgame mechanism @ 600 rpm • 11W - 2 motor kicker • 5.5 w- 1 motor De-scorer	4	4	2	5	15/25	11/20
Design 2: • 11 w - 6 motor drive @ 300 RPM + 4 omni wheels and 2 flex wheels • 11 w - 1 motor low-arc catapult @ 33 rpm • 11 w - 1 motor intake (w) 2 piston pneumatic push-out @ 600 rpm	5	7	4	7	23/25	18/20

Decision Matrix



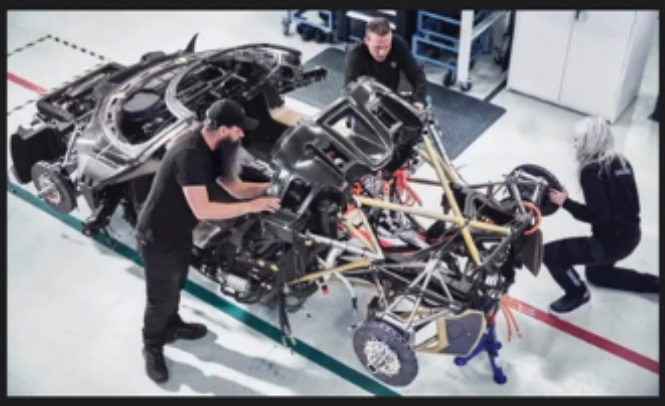
CAD Robot Chassis

STEP 4 - PROTOTYPE

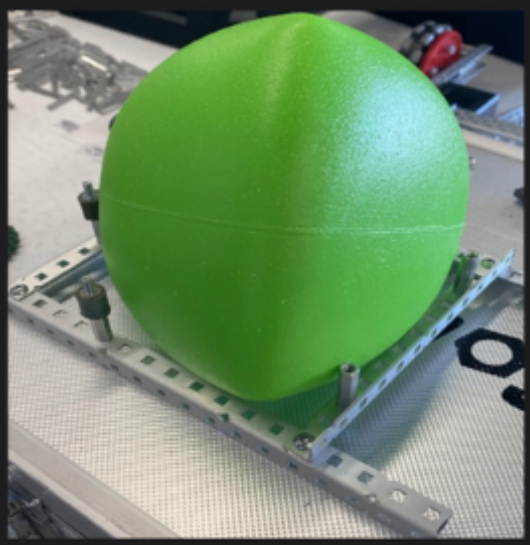
Early Koenigsegg prototypes played a crucial role in the company. While the CC prototype didn't become a production car, it served as a valuable foundation for future designs and prototypes.

Creating prototypes is key to refining and optimizing designs. In our first prototype, we constructed a box bed catapult - a mechanism that launched the main scoring element of our game. This prototype allowed us to create an initial model of our robot, and through testing helped us realize there were improvements needed.

Koenigsegg CC Prototype
(Year 1995)



Next-Gen Prototype



Box Bed Catapult

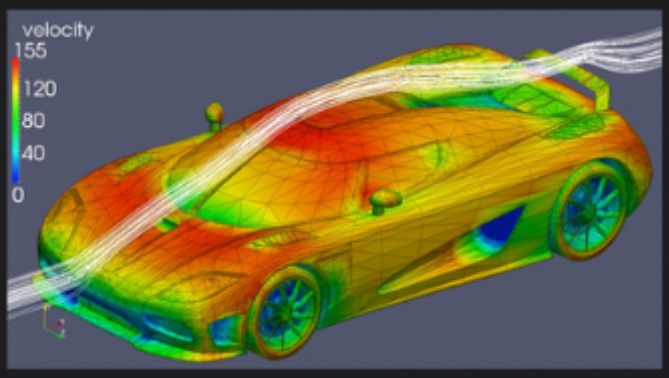
Robot Prototype

STEP 5 - TEST & ANALYZE

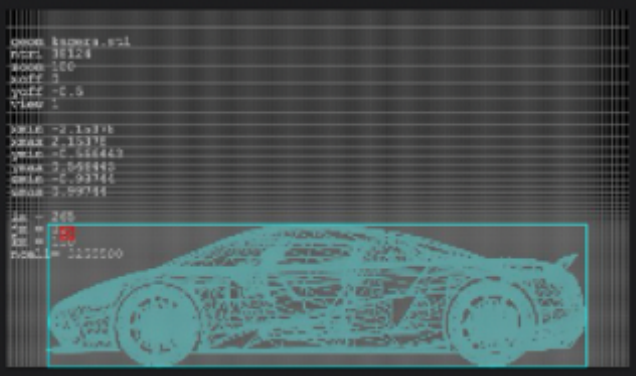
Transitioning from pre-production, Koenigsegg cars undergo crucial testing where every function is stress tested to ensure it meets high-quality performance standards.

During this phase, Mr. Lilja expertly drives the car to the brink and provides hands-on feedback to their engineering team.

Niklas Lilja - Post Drive Analysis



Velocity and Aerodynamic Efficiency



Computational Fluid Dynamics (CFD)

We also rigorously test our robot to ensure it aligns with defined goals and criteria. Our driver, Nehal Hara, provides feedback to the team based on his drive experience.

Recently, Nehal noticed our robot wasn't driving over the middle field barrier effectively. He relayed this to our team and we created a sleeker bottom design which solved the issue. Like Koenigsegg, communicating during the test phase helps us make iterative improvements.

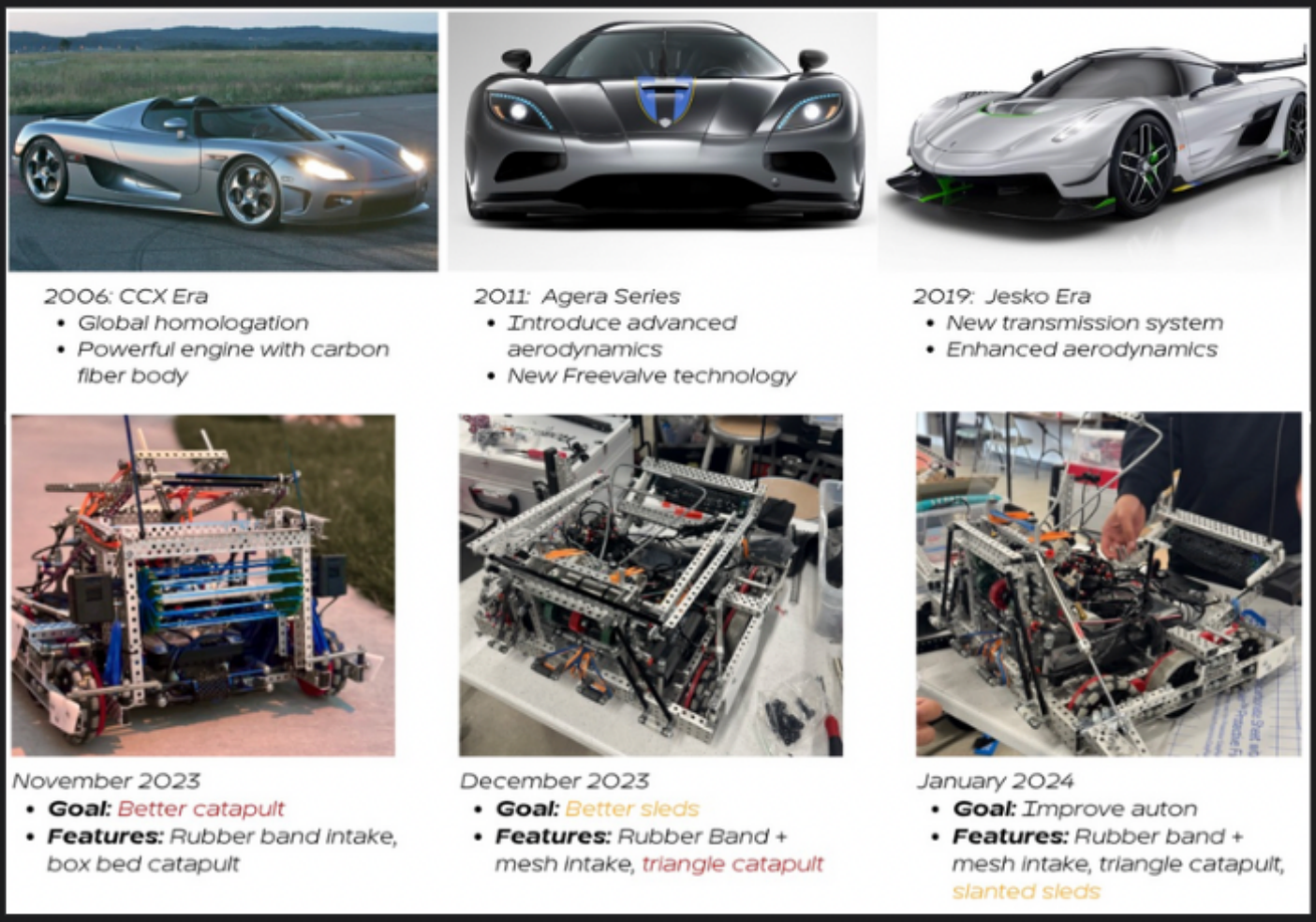
Drive Team

STEP 6 - ITERATE

Koenigsegg iterates so they can continually improve, even incorporating customer feedback. “We take pride in our customers because they also have a lot of ideas and share their experience of driving the Koenigsegg versus their other supercars.” - Niklas Lilja

Our robotics team also strives for continuous improvement, seeking feedback from other team members, veteran robotics students, and fellow competitors from other schools. Instead of settling for “good enough”, we continue to refine, optimize, and iterate.

This can be seen in the iterations of our robot throughout the year.

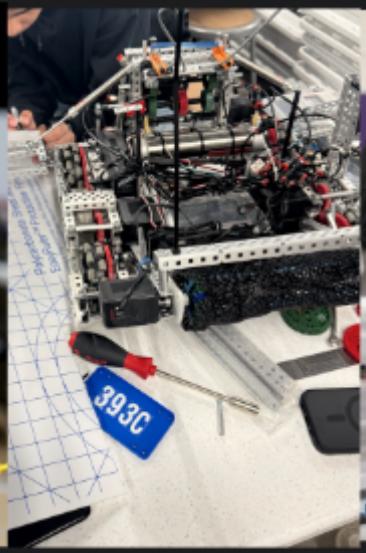


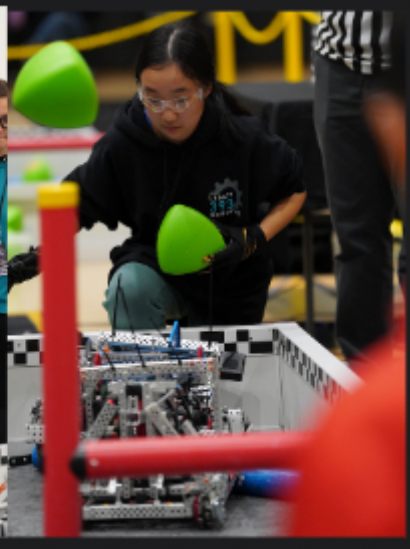
REVVING UP CAREERS THROUGH VEX

Some decades ago, a 14 year old boy modified and raced go-karts, dreaming to become a race car driver one day. He persistently learned the ins and outs of go-karting, understanding how every bolt, gear, and adjustment improved performance. His ideas and skills acquired led him to a career at Koenigsegg, contributing to the creation of the fastest cars in the world. This is the story of Niklas Lilja.

As VEX robotics students, we can learn from Lilja's story. VEX encourages a hands-on approach, teaching us to transform ideas into physical creations, and fostering a deep understanding of STEM skills. Beyond the robotics field, the engineering design process provides a universal problem-solving approach applicable to all areas of life. Additionally, VEX teaches students networking, encouraging engagement with judges and interviewers while fostering relationships and alliances within the robotics community.

From the field to the fast lane, this journey is about continuous growth, learning, and ultimately achieving greatness by believing in ourselves and the qualities that VEX instills in us.





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