# 2024 CRESCENDO Season

SPONSOR IMPACT REPORT

# Gene Haas Foundation

FRC ENIGMA 9080 · ENIGMA Green is Everywhere

Gold

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FRC PROGRAM

## FIRST Robotics Competition (FRC)

Learn more: https://www.firstinspires.org/robotics/frc

## A MESSAGE OF APPRECIATION

*“ENIGMA 9080 would not be the team we are without the support of our sponsors. Your investment does far more than help us buy robot parts, tools, registration, and travel support. It gives students the opportunity to discover engineering, programming, design, leadership, communication, and problem-solving in a real-world environment.*

*Because of your support, our students are able to build competitive robots, mentor younger teams, volunteer in the community, represent New Mexico at regional events, and grow into confident leaders. You help make it possible for students to take an idea from a sketch, to CAD, to fabrication, to competition, and along the way learn lessons that will stay with them far beyond robotics.*

*This season, your support helped ENIGMA continue building a stronger foundation for the future through new equipment, improved pit organization, outreach events, team mentorship, and hands-on STEM opportunities for students across multiple FIRST programs. Every match we play, every student we mentor, every robot we demo, and every problem we solve is connected to the generosity of people and organizations who believe in our mission.*

*Thank you for believing in our students, our team, and the future of STEM in New Mexico. Your partnership helps us build more than robots; it helps us build confidence, character, community, and the next generation of innovators.”*

Anisudh N. Cody S. Gray S. Hailey W. Ivana V. Kaitlyn F. Luke C. Nora L. Peter F.

Phillip M. Sammy G. Zachariah J. Russell M. Rey A. Noah S. Renzo D. Isabel M. Josh H.

Madelene C.

## About FRC ENIGMA 9080

Enigma's first FRC season was Charged Up 2023. We are a community team located in Albuquerque, New Mexico. We are currently growing our team and actively recruiting new members from grades 8-12. Our goal is to establish ourselves as helpful alliance members. We work hard at having fun and learning the concepts of STEAM education as we build really cool and effective robots. We are FRC Team 9080 ENIGMA

## By the Numbers

**1 and ONLY**
Sweet Baby Shane

**1**
Uranium Sponsor

**=ª**
Custom Retro Logo

**24"-x24"x27"**
Robot Dimensions

**>‡**
Roller Maracas

**1st Year**
Running Swerve

## Connect with the team

Instagram: https://instagram.com/enigma.robotics
YouTube: https://www.youtube.com/channel/UCziMRJj5j_hRYlwlJgXOjoQ
Facebook: https://www.facebook.com/enigma.robotics.program
Team Website: https://enigmafrc.com

# Students

### Anirudh N.

- Builder
- Fabricator
- Driver Mechanisms
- Drive Team
- Skilled 3D Prints
- Driver Chassis
- CAD Designer
- Electronics
- Outreach
- Fundraising
- Learning Java Code
- Assembly
- Rookie Year
- Team Media
- Team Spirit

### Cody S.

- Graphic Designer
- Outreach
- Social Media
- Fundraising
- Assembly
- Team Spirit
- Team Media
- Builder
- Rookie Year

### Gray S.

- Team Co-Captain
- CAD Designer
- Builder
- Drive Team
- Driver Chassis
- Wiring & Soldering
- Outreach
- Electronics
- Founding Member
- Design & Prototype
- Team Spirit
- Fundraising
- Judging Awards
- Game Manual Expert
- Fabricator
- Assembly
- Alumni

### Hailey W.

- Builder
- Fabricator
- Drive Team
- Driver Mechanisms
- Technician
- Wiring & Soldering
- Electronics
- Graphic Designer
- Team Spirit
- Founding Member
- Assembly
- Learning Java Code
- Team Media
- Game Manual Expert
- Design & Prototype

### Iriana V.

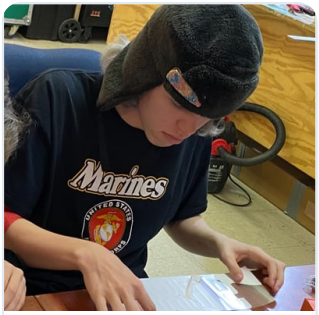
- Builder
- Team Co-Captain
- Graphic Designer
- Social Media
- Outreach
- Fundraising
- Assembly
- Team Spirit
- Team Media
- Team Photographer
- Game Manual Expert
- Judging Awards
- Design & Prototype
- Alumni

### Kaitlynn F.

- Team Media
- Team Spirit
- Judging Awards
- Game Manual Expert
- Graphic Designer
- Social Media
- Outreach
- Fundraising

### Luke C.

- CAD Designer
- Builder
- Fabricator
- Drive Team
- Technician
- Assembly
- Fundraising
- Design & Prototype
- Game Manual Expert
- Judging Awards
- Founding Member
- Team Spirit
- Outreach
- Skilled CNC Mill
- Skilled Bandsaw
- Driver Chassis
- Skilled 3D Prints
- Team Co-Captain
- Wiring & Soldering
- Electronics




### Nora L.

- Builder
- Fabricator
- Skilled CNC Mill
- Skilled Bandsaw
- Assembly
- Learning Java Code
- Wiring & Soldering
- Electronics
- Founding Member

### Peter F.

- Game Manual Expert
- Judging Awards
- Founding Member
- Design & Prototype
- Team Spirit
- Team Media
- Assembly
- Skilled Bandsaw
- Outreach
- Fundraising
- Drive Team
- Drive Coach
- Builder
- Fabricator
- Skilled 3D Prints
- Wiring & Soldering
- Electronics
- Alumni

### Phillip M.

- Builder
- Assembly
- Skilled CNC Mill
- Rookie Year
- Fabricator

### Sammy G.

- Outreach
- Fundraising
- Learning Java Code
- Team Spirit
- Builder
- Assembly

### Zacheriah J.

- Skilled Java Coder
- Skilled Vision Coder
- Skilled Autonomous Pathing
- Electronics
- Drive Team
- Technician
- Outreach
- Fundraising
- Learning Java Code

# Coaches and mentors

## GENE HAAS FOUNDATION

D

**Danny W.**
NM Field Office

- Grant Liaison

## FRC ENIGMA 9080

**Russell M.**
Coach #1

- Shop Admin
- Build & Fabrication
- Java Programming
- Wiring and Electronics
- Quality Control
- Machine Training
- Systems Mentor
- Design
- Game Strategy
- 3D Prints Mentor
- Robotics Control Systems
- Robotics Ambassador
- CAD Training
- Mechanical Engineering

**Rey J.**
Mentor

- Java Programming
- FRC WPI Programming
- Game Strategy
- Quality Control
- Robotics Control Systems
- Systems Mentor

**Noah S.**
Mentor

- FIRST Alumni
- Media Production
- Design
- Wiring and Electronics
- Quality Control
- Robotics Ambassador
- Game Strategy
- Robotics Control Systems
- Mechanical Engineering
- Build & Fabrication
- Systems Mentor

### Renzo D.
Mentor

- Systems Mentor
- Electrical Engineering
- Build & Fabrication
- Wiring and Electronics
- Quality Control
- Robotics Ambassador
- Game Strategy
- Mechanical Engineering
- Design
- Robotics Control Systems

### Isabel M.
Mentor

- Robot Driving
- Build & Fabrication
- Java Programming
- Quality Control
- Game Strategy
- Robotics Ambassador
- Robotics Control Systems
- Applied Mathematics
- Computer Science
- Systems Mentor
- Design
- FIRST Alumni
- FRC WPI Programming

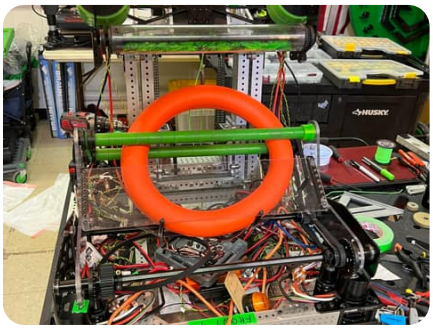
### Josh H.
Mentor

- Build & Fabrication
- Wiring and Electronics
- Quality Control
- Electrical Engineering
- Game Strategy
- Design
- Robotics Control Systems

### Madelene C.
Mentor

- Team Administrator
- Safety Coordinator
- Build & Fabrication
- Wiring and Electronics
- Quality Control
- Machine Training
- FIRST Alumni
- Systems Mentor
- Design
- Media Production

# Robot showcase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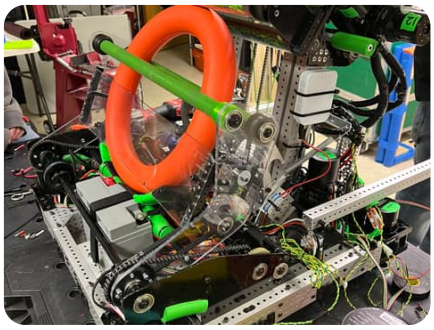
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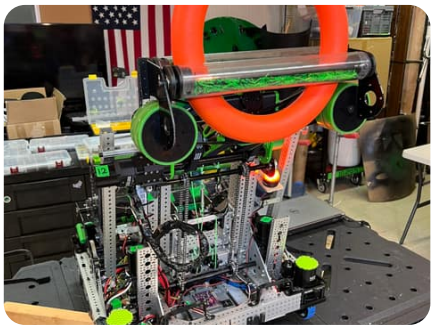
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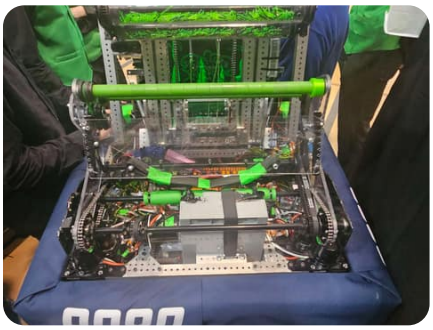
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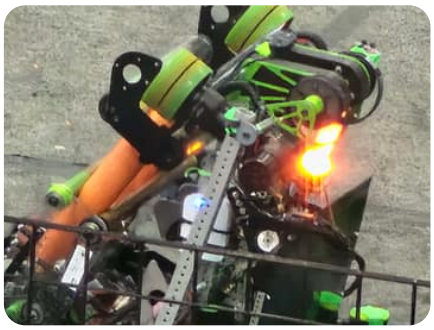
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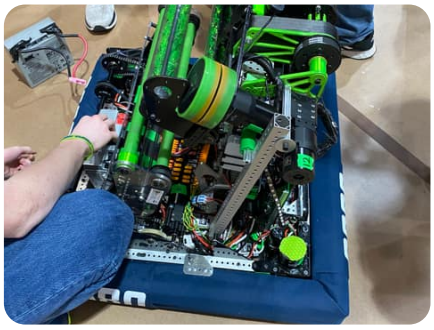
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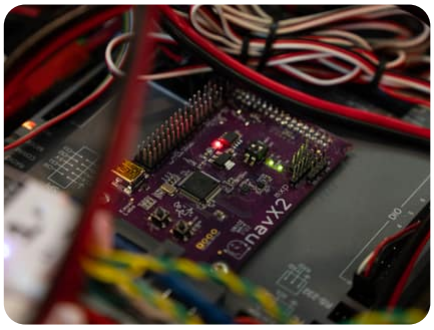
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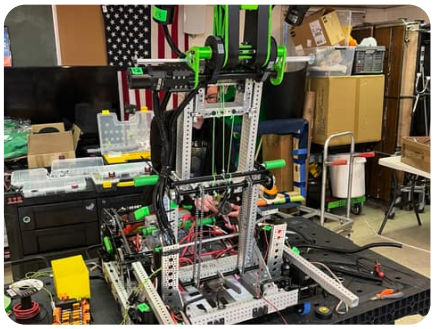

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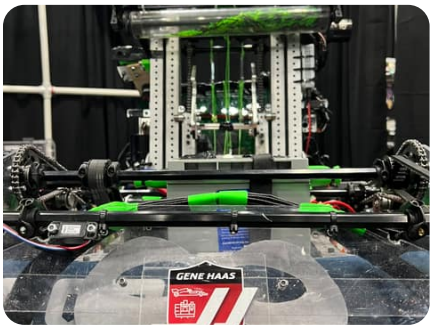


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# Year in review

CRESCENDO · Robot: Sweet Baby Shane

Total hours invested: 2,120

### OUR SEASON

The Decision to Attempt SwerveAt the end of the rookie season, Team 9080 knew that tank drive had given it a dependable introduction to FRC, but the students also saw the competitive advantages of swerve.

A swerve drivetrain can move in any direction while independently controlling robot orientation. It can strafe, translate diagonally, rotate while moving, and change direction without the turning arc required by a tank drivetrain.

For CRESCENDO, that offered several potential advantages:
Faster alignment with NOTES
Better movement around defenders
Quicker transitions between intake and shooting
Greater defensive maneuverability
More flexible positioning around the Stage
Reduced need for perfect chassis orientation
The concern was complexity.

Each module needed a drive motor, steering motor, encoder, mechanical zero, software offset, and properly tuned control loop. If even one module behaved incorrectly, the entire drivetrain could become difficult or impossible to control.

Other teams cautioned ENIGMA that a second-year team should not attempt swerve without having developed it during the previous offseason or season.

The students did not ignore that advice. They treated it as a warning about the amount of work required.

After researching multiple systems, they selected REV MAXSwerve.

The modules were compact, supported by available documentation and software resources, and compatible with the team's intended small chassis.

The decision represented a shift in ENIGMA's mindset. During the rookie season, the goal had been to field a robot and survive. In year two, the students were willing to accept greater technical risk in order to expand what the team could learn and accomplish.
Naming Sweet Baby ShaneCRESCENDO also gave ENIGMA an opportunity to rethink how the team recognized major sponsors.

A supporter provided funding in exchange for the opportunity to name the season's robot. The resulting name was Sweet Baby Shane.

Rather than treating the name as a small label placed on the frame, the students developed a complete visual identity around it.

They created a bold, custom logo inspired by the flowing psychedelic lettering of the 1970s. The design used ENIGMA's bright green against black, making the name highly visible and giving the robot a memorable personality at competitions.

The name and logo became conversation starters in the pit, inspection line, stands, and competition field. Other teams, volunteers, judges, and visitors frequently asked about Sweet Baby Shane and the story behind the name.

To thank Shane personally, the team also created a custom laser-etched plaque. The plaque incorporated the Sweet Baby Shane artwork, team branding, a photograph, and signatures from students and coaches.

The finished piece gave the sponsor something tangible that represented both his contribution and the students whose season he helped make possible.

The sponsorship inspired ENIGMA to establish the Uranium Level Sponsor, a premium sponsorship tier that could include naming rights and highly personalized recognition.

This approach demonstrated that sponsorship does not need to be limited to placing a company logo on a banner. A team can create memorable experiences and meaningful recognition that make supporters feel personally connected to the students and the robot.
Learning From the Wider FRC CommunityThe students did not begin designing in isolation.

After the CRESCENDO reveal, they studied numerous Robots in 3 Days concepts. Ri3D teams rapidly prototype mechanisms immediately after kickoff, giving the FRC community early examples of possible intakes, shooters, elevators, climbers, and transfer systems.

The students compared several ideas rather than copying one complete robot.

They looked at:
Over-the-bumper intakes
Under-the-bumper intakes
Horizontal rollers
Pivoting intakes
Direct-feed shooters
Adjustable-angle shooters
Fixed-angle shooters
Elevator-supported shooters
Trap mechanisms
Climbing concepts
Compact chassis layouts
The team also discovered the David's Design Discord server.

That community became a valuable design resource. Students could examine concepts, see how experienced

designers approached packaging problems, and understand why some mechanisms worked better than others.

The server did not design ENIGMA's robot for the students. It helped them develop the vocabulary and perspective needed to make better decisions.

The combination of Ri3D research, Discord discussion, mentor input, and student CAD work made CRESCENDO a major step forward in the team's engineering process.
Gray and Peter Lead the CADGray and Peter carried much of the robot's CAD responsibility.

They took the team's strategic ideas and worked through the physical relationships among the drivetrain, intake, shooter, elevator, electronics, bumpers, and frame perimeter.

This required more than placing components into a digital assembly.

They needed to consider:
Starting configuration
Frame perimeter
Bumper clearance
Shooter trajectory
Intake reach
NOTE compression
Center of gravity
Elevator travel
Chain and belt paths
Maintenance access
Structural support
Wire routing
Module clearance
Overall height
The robot's small dimensions made packaging more difficult, not less.

Every mechanism competed for the same limited space.

The CAD process helped the team discover conflicts before manufacturing and gave students a clearer picture of how the robot would assemble.
A 24-by-24-Inch ChassisENIGMA chose a compact 24-by-24-inch chassis.

The small frame reduced the robot's footprint and helped it navigate congested areas around the Stage.

It also made the robot easier to transport and created a visually distinctive machine.

The final robot fit perfectly inside a green road case. That case doubled as the robot cart, giving the team a compact transportation system that drew compliments at events.

The road case reflected the practical value of the robot's size:
Easier loading
Better protection
Less storage space
Faster movement through venues
A clean and professional pit presence
No separate oversized robot cart
The small chassis came with tradeoffs. Mechanisms were tightly packed, access could be difficult, and the elevator, shooter, intake, and electronics all needed to coexist within a restricted volume.

But the students learned to treat physical space as an engineering resource.
Staying Under 27 InchesThe robot was designed to remain under approximately 27 inches tall in its normal configuration.

A low profile helped with stability and gave the team room to deploy the elevator upward.

It also reduced the chance of mechanisms interfering with field structures during normal movement.

Keeping the robot low while still incorporating an elevator and adjustable shooter required careful packaging.
Over-the-Bumper Ground IntakeThe team built an over-the-bumper intake to collect NOTES directly from the carpet.

The intake extended beyond the frame, contacted the flexible ring-shaped game piece, and pulled it into the robot.

NOTES behaved differently from rigid FTC game pieces. They could flex, fold, twist, bounce, and resist entering a mechanism if compression was uneven.

The team needed to determine:
Roller material
Roller spacing
Intake speed
Compression
Entry angle
Side guides
Transition geometry
Retention
Transfer timing
The intake needed to collect quickly while avoiding jams and damage.

Because the robot used swerve, Gray could approach NOTES from many angles rather than always lining up straight ahead.
Intake-to-Shooter TransferAfter the intake acquired a NOTE, the game piece moved into the shooter.

A reliable transfer was essential. A robot could have a fast intake and powerful shooter but still lose valuable time if the NOTE stalled between them.

Students learned that the transitions between mechanisms are often more difficult than the mechanisms themselves.

The NOTE needed to remain controlled as it passed through changing compression, direction, and speed.
Adjustable ShooterThe shooter could change its angle to support shots from different positions.

An adjustable shooter offered greater field flexibility than a fixed-angle system. In theory, the team could tune the launch angle and wheel speed for several distances.

That flexibility also added complexity.

The mechanism needed:
Repeatable position control
Structural rigidity
Motor control
Position feedback
Mechanical limits
Software limits
Reliable return to presets
Protection against overtravel
The students continued learning that every adjustable mechanism requires control systems as well as mechanical construction.
The ElevatorThe shooter was connected to an elevator.

The elevator was intended to support several functions:
Change scoring position
Raise the mechanism for hanging
Place a NOTE into the Trap
Move the shooter or scoring assembly through different configurations
This created a highly ambitious multi-purpose system.

Combining several game tasks into one mechanism can reduce the number of separate assemblies on a robot, but it also increases the consequences when that mechanism fails.

The elevator became one of the most important—and most challenging—parts of the robot.
The Trap Became the TrapCRESCENDO included an endgame task called the Trap.

A robot could climb onto the Stage and place a NOTE into a small scoring area.

The challenge looked impressive and carried strategic appeal, but it required accurate positioning, significant vertical reach, stable control, and a mechanism capable of handling large loads near the end of a match.

ENIGMA invested substantial design effort into making the elevator perform both hanging and Trap scoring.

Over time, the students realized that the Trap had become a distraction from higher-value improvements.

The mechanism was difficult to develop reliably, consumed design time, increased weight, complicated the elevator, and introduced failure points.

The team learned a strategic lesson that would influence future seasons:

Every game has a proverbial trap—an objective that looks important or exciting but may consume more resources than it contributes to match success.

In CRESCENDO, the proverbial trap was literally the Trap.

The experience taught the students to evaluate mechanisms not only by whether they could be built, but by:
Point value
Frequency of use
Reliability
Development time
Weight
Complexity
Effect on other systems
Alliance value
Opportunity cost
Swerve Worked—At Least on the Practice CarpetThe team successfully assembled, configured, and coded the REV swerve drivetrain.

That accomplishment alone was significant for a second-year program.

ENIGMA's available practice area was a small portable carpeted surface, roughly half of a full field.

On that carpet, the robot appeared quick.

The students saw rapid direction changes and smooth strafing and believed the drivetrain was performing well.

Then they arrived in Fort Worth.

On a full competition field, surrounded by mature robots with highly tuned drivetrains, ENIGMA looked slow.

The small practice space had hidden the problem. The robot rarely had enough distance to reach or demonstrate full speed.

What felt fast in the shop was crawling on the competition field.
Help From the RoboChargersThe speed issue could have damaged the team's entire Fort Worth event.

Fortunately, the RoboChargers had a mentor with deep knowledge of REV swerve. He had helped write the REV swerve

libraries and understood the system at a level ENIGMA did not yet possess.

He worked with the team, identified the configuration or software limitations holding the drivetrain back, and helped correct the speed problem.

The experience became one of the clearest examples of Gracious Professionalism during the season.

A mentor from another team did not merely give ENIGMA a vague suggestion. He shared specialized knowledge that allowed the students to unlock the drivetrain they had worked so hard to build.

The lesson was not that ENIGMA had failed by needing help.

The lesson was that advanced engineering communities grow when experts are willing to teach and students are willing to admit what they do not know.
Gray Becomes a Swerve DriverGray drove the robot and became increasingly comfortable with swerve throughout the season.

Swerve required a different style from tank drive.

The driver needed to manage translation and rotation independently, maintain field awareness, collect NOTES from different angles, avoid defenders, and reposition quickly.

Gray developed particular skill in defense.

The compact chassis and omnidirectional movement allowed ENIGMA to:
Stay between an opponent and its target
Change direction rapidly
Rotate while maintaining position
Block travel lanes
Force opponents into longer routes
Recover after being outmaneuvered
Driving defense effectively requires judgment. Excessive contact can create penalties, while passive movement allows opponents to pass.

Gray learned how to pressure other robots without losing control of ENIGMA’s own position.
PID Control ChallengesAlthough the team made a major jump in mechanical design, software control of the mechanisms remained a weakness.

The students struggled with PID control for the elevator, shooter adjustment, and other motor-driven systems.

Without properly tuned feedback, mechanisms could:
Overshoot target positions
Continue moving after reaching a limit
Oscillate

Stall against hard stops
Apply excessive force
Damage structure
Lose calibration
These overruns caused physical damage that the team needed to repair.

The experience demonstrated that a mechanism is not finished when it moves.

It is finished only when it can move:
To the correct position
At a controlled speed
Without damaging itself
Repeatedly
Under changing loads
During competition
Learning Material Tolerances the Hard WayThe team also learned about material tolerances and load paths during a hanging attempt.

As the elevator tried to lift the robot and position a NOTE in the Trap, the loads exceeded what the structure or attachment points could tolerate.

The elevator tore away from the robot.

This was one of the season's most dramatic failures.

The damage revealed that parts which appear strong enough during normal scoring may behave very differently when supporting the weight of an entire FRC robot.

The team learned to consider:
Tensile load
Shear
Bending
Fastener pullout
Material thickness
Hole spacing
Edge distance
Repeated stress
Shock loading
Safety factors
The elevator failure was costly, but it gave the students a practical understanding of structural engineering that no classroom explanation could fully reproduce.
Fort Worth District EventENIGMA entered the Fort Worth District Event still learning how fast its new drivetrain could—and should—move.

The team finished qualifications ranked 24th.

Despite that ranking, Team 9080 was selected as the second pick of Alliance 4 by Team 6672, Fusion Corps, and Team 4206, Robo Vikes.

The alliance advanced through the lower bracket, winning several elimination matches and reaching the event finals.

ENIGMA finished as a District Event Finalist.

The result was significant for a second-year team, particularly after arriving with a drivetrain that initially moved far below its potential.

Fort Worth showed that Team 9080 could contribute to a strong playoff alliance through defense, mobility, reliability, and strategic play.

It also reinforced the value of accepting help from other teams.
Amarillo and a Dream ScheduleAt Amarillo, ENIGMA received an unusually favorable qualification schedule.

The team performed well and rose near the top of the rankings.

The Blue Alliance officially records Team 9080 as the third-ranked team after qualifications, although the team functioned as captain of the second-seeded alliance due to the movement created during alliance selection.

Peter, serving as drive coach, recognized that alliance selection would require strategy beyond simply naming the preferred partners.

Some highly ranked teams were likely to decline ENIGMA because they expected to captain their own alliances.

Peter used that expectation strategically.

ENIGMA called teams near the top of the rankings that it knew were likely to decline. Once those teams declined an invitation, they could no longer accept invitations from later alliance captains.

This prevented some top-ranked teams from pairing with one another.

The strategy altered the available alliance combinations and helped protect ENIGMA’s competitive position.
Alliance Chemistry Over RankingsThe alliance-selection process also taught ENIGMA that the highest-ranked available robot is not always the best partner.

A strong alliance depends on more than individual scoring averages.

The team considered:
Driver communication
Autonomous compatibility

Preferred field roles
Defensive ability
Reliability
Pit cooperation
Match strategy
Trust
Personality
Ability to adjust under pressure
ENIGMA selected Team 6369, Mercenary Robotics, and Team 6974, Zia Robotics.

The alliance did not advance far in the playoffs, but the experience reinforced the importance of choosing teams with complementary capabilities and strong chemistry.

The students learned that rankings describe what happened during qualifications. They do not automatically predict which three teams will function best together.
Quality AwardENIGMA earned the Quality Award at Amarillo.

The award recognized the robustness, workmanship, maintainability, and thoughtful engineering demonstrated by the robot.

This was especially meaningful after a season filled with difficult failures and repairs.

The robot had experienced:
Swerve configuration challenges
Mechanism overruns
Elevator damage
Structural failures
Material tolerance issues
Repeated competition repairs
Yet the students continued rebuilding, improving, and presenting a machine that demonstrated substantial design growth from their rookie season.

The award acknowledged not perfection, but the team's progress toward quality engineering.
Returning to District ChampionshipENIGMA qualified for the FIRST in Texas District Championship for the second consecutive season.

The team competed in the Apollo Division and finished qualifications ranked 21st with a 6–6 record.

The improvement from the previous year was clear.

As rookies, ENIGMA had finished 38th in Apollo at 3–9. In year two, the team climbed to 21st and doubled its number of wins.

The team did not advance to the playoffs, but its performance showed that the program was moving forward.

A Second-Year Team Becoming an FRC TeamCRESCENDO was the season in which Team 9080 began to look and operate less like a new team trying to survive and more like an established program learning how to compete.

The students had:
Designed a complete robot in CAD
Adopted swerve drive
Developed a compact custom chassis
Built an over-the-bumper intake
Created an adjustable shooter
Integrated an elevator
Attempted hanging and Trap scoring
Repaired major structural damage
Reached an event final
Captained a playoff alliance
Earned the Quality Award
Returned to District Championship
The season was not smooth.

That was precisely why it mattered.

## GOALS

Move Beyond the Kit DrivetrainAfter using the AndyMark tank chassis as rookies, the team wanted to develop a more advanced drivetrain.

Swerve became the primary technical goal.
Learn REV MAXSwerveThe students needed to understand:
Mechanical assembly
Wheel alignment
Encoder offsets
Steering motors
Drive motors
Module orientation
Swerve kinematics
Field-relative control
Odometry
Software configuration
Develop a Complete CAD ModelThe team wanted to design the robot digitally before and during fabrication.

Gray and Peter led the CAD effort.
Build a Compact RobotThe 24-by-24-inch chassis and low overall height were intended to improve maneuverability, storage, transport, and stability.
Collect NOTES From the FloorThe robot needed a reliable over-the-bumper ground intake that could acquire game pieces without human loading.
Shoot From Multiple LocationsAn adjustable shooter would give the team more scoring flexibility than a single fixed

position.
Climb on the StageThe elevator needed to support a hanging attempt during endgame.
Score in the TrapThe team pursued Trap scoring, although it later learned that the mechanism's complexity and low frequency of use did not justify the resources it consumed.
Improve Competitive PerformanceAfter the rookie year, ENIGMA wanted to:
Reach playoffs consistently
Improve event rankings
Return to District Championship
Become a desirable alliance partner
Demonstrate reliable defense
Increase scoring capability
Build Stronger StrategyThe team wanted to improve scouting, alliance selection, and drive-team planning.
Learn From Other TeamsThe students recognized that FRC expertise exists throughout the community.

Accepting help from the RoboChargers became an important example of this goal.
Develop Mentor RelationshipsJason, Noah, Josh, Aaron, and Jake provided important technical and strategic mentorship throughout the season.

Their involvement expanded the team's access to knowledge in design, manufacturing, controls, troubleshooting, and competition strategy.

## Lessons learned

Small Practice Spaces Can Hide Big ProblemsThe robot looked fast on ENIGMA's half-size portable carpet.

On the full Fort Worth field, it was clearly too slow.

Students learned that a system must be tested under conditions that resemble actual use.
Ask for Help Before the Event Is LostThe RoboChargers mentor helped ENIGMA correct the swerve speed issue.

The team learned that asking for expert assistance is not surrendering ownership. It is part of engineering.
Advanced Drivetrains Require More Than AssemblyBolting together four swerve modules does not create a competitive swerve drivetrain.

Calibration, software, ratios, limits, and control settings matter just as much as hardware.
Every Game Has a TrapSome scoring objectives consume far more design effort than their match value justifies.

The literal Trap taught the team to examine opportunity cost.
Mechanisms Must Earn Their ComplexityThe adjustable shooter and elevator offered flexibility, but they also increased programming and structural demands.

Future designs would need clearer justification for each degree of freedom.
PID Is Structural ProtectionPoor control tuning did more than reduce accuracy. It caused mechanisms to overrun and damage themselves.

Software control is part of mechanical reliability.
Full Robot Weight Changes EverythingThe elevator survived normal movement but failed during a hanging attempt.

Students learned to test mechanisms at realistic load and include safety factors.
Material Tolerance MattersSmall differences in hole placement, fastener clearance, material thickness, and fit can become major failures under load.
Rankings Can Be MisleadingAmarillo's favorable schedule helped ENIGMA reach the upper rankings.

The students understood that ranking alone did not tell the complete story of robot capability.
Alliance Selection Is StrategicPeter's approach showed that the order in which teams are invited can shape the entire playoff field.
Chemistry MattersA slightly lower-ranked robot with a compatible role and cooperative drive team may be more valuable than a higher-ranked robot that duplicates the same strengths.
Defense Is a SkillGray learned that good defense depends on positioning, timing, control, and penalty awareness—not simply contact.
Quality Includes RepairabilityA robot will fail.

Quality engineering includes making damage understandable and repairable.

## Skills and growth

Swerve AssemblyStudents built and maintained REV MAXSwerve modules.
Swerve ProgrammingThe programming team learned:
Module states
Steering angles
Wheel speeds
Encoder offsets
Field-relative control
Kinematics
Odometry
Module optimization
Full-Robot CADGray and Peter developed a complete digital assembly around the robot's compact frame.
Design ResearchStudents learned how to evaluate Ri3D concepts and community designs without copying them blindly.
Discord-Based Technical CollaborationDavid's Design exposed students to design reviews, alternative concepts, and experienced feedback.
Over-the-Bumper Intake DesignThe intake taught students how flexible NOTES respond to compression, roller speed, and guide geometry.
Shooter DesignStudents developed experience with:
Flywheel velocity
Compression
Hood angle
Trajectory
Range adjustment
Transfer timing

Elevator ConstructionThe elevator introduced:
Linear motion
Load support
Stage alignment
Hanging forces
Mechanism integration
Structural reinforcement
PID ControlThe team gained firsthand experience with overshoot, tuning, limits, and mechanism protection.
Material Failure AnalysisThe elevator failure showed students how to inspect broken parts and identify likely load paths.
Swerve DrivingGray learned to translate, rotate, strafe, and defend with independent motion control.
Defensive StrategyThe team developed the ability to disrupt opponents while avoiding penalties.
Alliance SelectionStudents learned how scouting data, chemistry, and invitation order affect playoff alliances.
Drive CoachingPeter gained experience managing alliance conversations, match strategy, and the psychology of alliance selection.
Pit RepairThe season required repeated mechanical recovery under time pressure.
Mentor CollaborationJason, Noah, Josh, Aaron, and Jake helped students connect design theory with competition reality.
Growth Beyond the RobotThe greatest change was not the move from tank drive to swerve.

It was the move from asking, “Can we build this?” to asking:
Is this worth building?
How will we control it?
How will we test it?
What happens when it fails?
Does it make the alliance stronger?
Can the driver use it consistently?
Does the point value justify the complexity?
Who can help us understand what we are missing?
Those are the questions of a maturing FRC team.

# Competitions

### FIRST in Texas District Fort Worth Event

Mar 16, 2024 · Nolan Catholic High School Fort Worth, Texas

**8-11, District Event Finalist**

Fort Worth was ENIGMA's first official competition with swerve drive.

The team arrived believing the drivetrain was fast because it had looked quick on the small portable carpet at the shop. On the full field, however, the robot moved far more slowly than established teams.

A RoboChargers mentor who had helped develop REV's swerve libraries worked with ENIGMA and corrected the issue. His assistance transformed the drivetrain and allowed the students to experience the performance they had intended to build.

ENIGMA finished qualifications ranked 24th and entered the playoffs as the second selection of Alliance 4 alongside captain Team 6672, Fusion Corps, and first selection Team 4206, Robo Vikes.

The alliance advanced through the bracket, earned several playoff victories, and reached the event finals.

ENIGMA finished as a District Event Finalist with an overall event record of 8–11.

The event showed that the compact robot could contribute through mobility, defense, and strategic flexibility even while its scoring mechanisms remained inconsistent.

Fort Worth also reinforced one of the most important values of FRC: a team's season can be changed by another team's willingness to share expertise.

## FIRST in Texas District Amarillo Event

Mar 30, 2024 · Amarillo Civic Arena

**11-1, Rank #2, Quality Award**

ENIGMA arrived in Amarillo with a more capable drivetrain, a more confident driver, and a clearer understanding of the robot's strengths.

A favorable qualification schedule helped the team rise near the top of the rankings. ENIGMA officially finished qualifications ranked third with an 11–1 qualification record and an 11–3 overall event record.

During alliance selection, Team 9080 became captain of Alliance 2.

Peter, serving as drive coach, used the selection process strategically. ENIGMA invited several highly ranked teams it expected would decline because they intended to captain their own alliances. Once they declined, those teams could no longer accept invitations from later captains, preventing some top teams from combining.

ENIGMA ultimately selected Team 6369, Mercenary Robotics, and Team 6974, Zia Robotics.

The alliance was eliminated after two playoff matches, but the event taught ENIGMA that successful alliance formation depends on more than rank. Chemistry, complementary abilities, autonomous compatibility, communication, and trust can matter as much as qualification position.

ENIGMA also earned the Quality Award, recognizing the robot's engineering, workmanship, and durability.

The award reflected how far the team had progressed from its rookie season, even though the robot still required significant repairs and refinement.

## FIRST in Texas District Championship — Apollo Division

Apr 6, 2024 · George R. Brown Convention Center, Houston, Texas

**6–6 record, Ranked 21st**

The team did not advance into the playoffs, but the results represented major progress from the previous season, when ENIGMA had finished 38th in the same division structure with a 3–9 record.

The District Championship placed the team against highly refined robots, experienced drive teams, and programs with advanced autonomous and mechanism control.

The event reinforced the importance of reliability, PID tuning, structural safety factors, and selecting game objectives based on strategic value.

CRESCENDO ended with ENIGMA no longer feeling like a team that had simply survived its second season. The students had designed a custom compact robot, implemented swerve, reached an event final, captained an alliance, won the Quality Award, and proved they could compete credibly within the Texas district.

## Outreach

Sharing the Swerve JourneyAs a second-year team attempting swerve, ENIGMA's experience became a useful story for younger teams and students.

The team could demonstrate that difficult technologies are approachable when students research, ask questions, test, fail, and seek help.
Learning Through CommunityThe team's design process depended on the broader FRC community.

Ri3D teams shared early mechanism concepts.

David's Design created a place for technical discussion.

The RoboChargers shared specialized software expertise.

Other teams offered feedback, parts, and competition support.

ENIGMA learned that participation in FRC is itself a form of engineering outreach. Knowledge flows between teams constantly.
A Compact Robot as an Outreach ToolThe green road case drew attention at competitions.

Visitors often commented on how perfectly the robot fit inside and how the case doubled as a cart.

This created easy opportunities for students to explain the robot's compact design philosophy and transportation planning.
Supporting Alliance PartnersThe team placed increasing emphasis on communication and chemistry with alliance partners.

Students learned to listen to other drive teams, understand their preferred roles, and develop strategies that allowed each robot to contribute.
Mentors Expanding Student CapabilityJason, Noah, Josh, Aaron, and Jake gave students access to experienced perspectives they could not have developed in only two seasons.

Good mentorship did not remove student ownership. It helped students ask better questions, understand failures, and make more informed decisions.

# Season highlights

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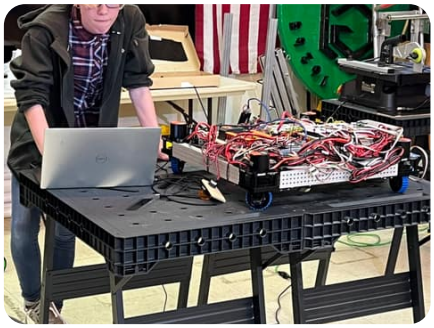
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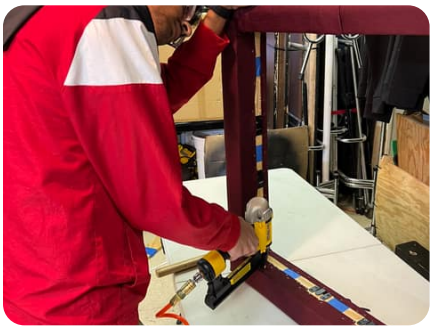
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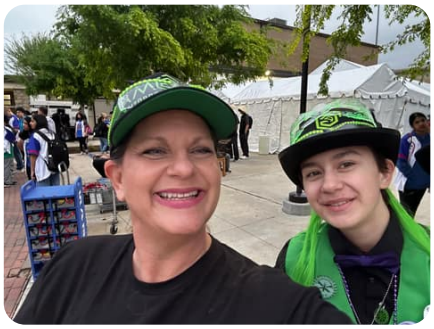

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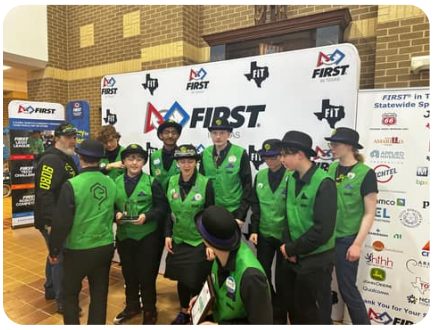


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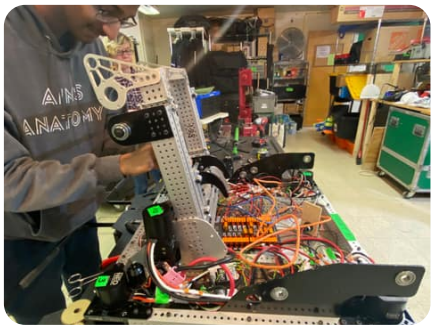


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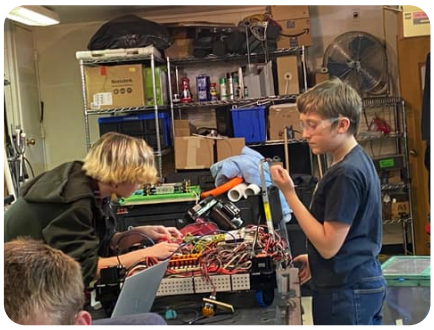

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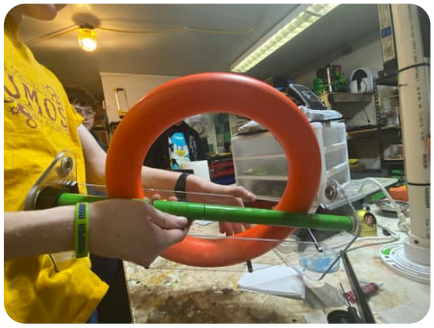

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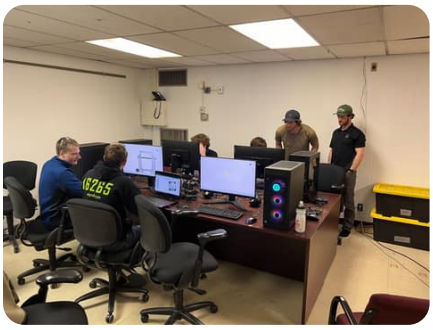

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