

South Dakota 4-H Robotics & Engineering 2021 Challenge Packet

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Event Overview

The South Dakota 4-H Robotics Challenge is an opportunity for youth who have been learning about robotics to demonstrate their learning, celebrate their accomplishments, and interact with others who share an interest in robotics.

New for 2021

- Advanced Division is now called the Recreational Division. This is the Non-Competitive division.
- Recreational (Non-Competitive) Division teams will now work on the autonomous and junk drawer challenges during the same work period.
- Autonomous Challenges for both the Recreational and Competitive Divisions will be built on VEX IQ Challenge Field Perimeter & Tiles.
- Competitive Division will only have one board for their autonomous challenge.

Event Location

The event will be held Saturday, September 4th on the South Dakota State Fairgrounds, Huron, SD. The challenge will be held in the Nordby Exhibit Hall on the State Fair Grounds.

Tentative Schedule

8:30 Recreational teams check-in: Receive team table assignment

8:50 Recreational Autonomous and Junk Drawer rules and challenge release

9:00-11:00 Recreational team work period (Autonomous and Junk Drawer)

11:30 Recreational presentations

1:00 Competitive Division teams check-in: Receive team table assignment

1:20 Competitive Division Team Challenge rules and challenge released

1:30-3:30 Competitive Division team work period

3:30 Final judging Competitive Division

4:15 Awards for Competitive Division (this may be earlier or later depending on number of teams)

**This schedule is tentative and subject to change based on facility capacity and number of teams and SDSU Extension Covid-19 policies and procedures.*

Eligibility

1. Team registration is taken on a first-come-first-serve basis through August 10, 2021. This registration deadline will be strictly enforced.
2. Teams **must have at least two members with a max of 4.**

3. Recreational and Competitive team members need to be proficient with their chosen platform before the event.
4. All participants must be at least 8 years of age by January 1, 2021, but not have turned 19 years old prior to January 1, 2021.
5. The Recreational Division is for all 4-H ages (8-18).
6. The Competitive Division is divided into age groups Beginner/Junior (8-13) and Senior (14-18). The committee reserves the right to divide teams into appropriate groupings during check-in.

Event Content

The South Dakota 4-H Robotics Challenge is divided into a Recreational and a Competitive division. After check-in and set-up, teams will gather for the Challenge Release. Each team within a division will receive their Challenge at the same time. Time has been allotted for questions and clarification after the Challenge Release. After the Challenge Release, each team returns to their pit area to program their robot to complete the tasks outlined in the challenge. After the work period, each team will make a final run on the challenge boards to be scored.

Recreational

This division is for youth (ages 8-18) who have minimal experience with autonomous robot platforms (LEGO®, VEX, etc.) and junk drawer robotic designs. Recreational Teams will have two hours to work on both the Autonomous Challenge (Appendix A) and the Junk Drawer Challenge (Appendix B)

In the Autonomous Challenge, Recreational Teams will design, build, and program a robot to accomplish the tasks laid out in the appendix. It is **highly encouraged that the majority of the build and programing is completed prior to arriving at the fair.** They may use a stock build or design their own.

In the Junk Drawer Robotic Challenge, teams are provided a 'trunk of junk' that they must utilize to complete a task. This challenge requires teams to be creative and use their engineering skills. Teams may only use materials provide at the challenge release. **It is highly encouraged that your team spends time with the 4-H Junk Drawer Robotics Curriculum** to prepare for this challenge. A sample of the curriculum can be found at <https://4-h.org/parents/curriculum/robotics/>.

Both challenges in the Recreational Division are modified real time challenges; this means that portions of the challenges are provided in Appendix A & B, but teams need to be prepared to adapt to minimal changes on the day of the challenge.

In addition to being judged on the completion of both challenges, teams will also be judged on 4-H Values and the Engineering Design of their robots and programs.

Competitive Division

This division is for youth wishing to try a competitive robotics event. The team should have previous experience using an autonomous robotics platform (LEGO® MINDSTORMS®, VEX, TETRIX®, etc.) and arrive at the challenge with their robot built and programmed.

The Competitive Division is a modified real time challenge; this means that portions of the challenge can be found in the Appendices, but teams will not necessarily know everything about the challenge prior to the event. The competitive division will be divided into two categories Beginner/Junior (ages 8-13) and Senior (ages 14-18). Points will be awarded based upon how much of the challenge is completed, as well as for team work and technical understanding. The point breakdown can be found in the Appendix with the corresponding challenge.

The teams will have **two** hours to complete both the autonomous challenge and the junk drawer challenge. It is up to them to decide how they will budget their time. During this time judges will ask questions about what they are doing/have done and will be observing their teamwork.

Teams are required to record their building and programming process in their **Engineering Notebook** as they

prep for the challenge. These records will count towards their final score and can be used as the determining factor in case of a tie.

Part 1: One Autonomous robotic challenge can be found in Appendix A. Teams will need to arrive at the competition with their robots constructed and prepared to run **the one challenge for their age division**. The day of the Challenge, teams will find the course to be slightly modified (locations may be changed or steps may be added) and released to teams the day of the challenge. Teams must be familiar enough with their program that they can easily adjust their program to complete the Final Challenge.

Part 2: Junk drawer robotics challenge found in Appendix B, does not use a robotics platform, rather teams are provided a ‘trunk of junk’ that they must utilize to complete a task. This challenge requires teams to be creative and use their engineering skills. Teams may only use materials provide at the challenge release. The Challenge is introduced in Appendix B, but the materials within the ‘trunk of junk’ will remain a mystery until the Challenge day. **It is highly encouraged that your team spends time with the 4-H Junk Drawer Robotics Curriculum** to prepare for this challenge. A sample of the curriculum can be found at <https://4-h.org/parents/curriculum/robotics/>.

Part 3: 4-H Values and Engineering Design During the two hours that teams have to work on the robotic challenges, they will also be judged on their 4-H Values and the Engineering Design of their robots and programming. 4-H Values judging will evaluate how well the 4-H members work as a team and overcome any challenges they may encounter. Engineering Design judging will look at the complexity of their robots and programming, how efficient they are, and how well the design of the robot and program were documented in the teams Engineering Notebooks. The scoring rubric for both 4-H Values and Engineering Design can be found in Appendix D.

Awards for Competitive Division

Award	Description
Clover Award	Team notable for exemplarity demonstration of 4-H values
4-H Robotics Award	Top scoring team from all areas
Engineering Design Award	Top scoring team for engineering design

What to Bring

1. An autonomous robot, your Engineering Notebook, and computer to adjust your robots program.
2. Robot garages—It will happen ... someone will drop their robot and watch the parts explode in a million directions. It's not pretty. BRING A PLASTIC CONTAINER LARGE ENOUGH TO CARRY YOUR ROBOT DURING THE EVENT. If it drops, you have a better chance of collecting all of the parts and reassembling your robot.
3. Knowledge of how to build and program using their chosen platform—you will not have time to learn at the event, but we will have technical advisors available.
4. Your teamwork and engineering skills—this is your chance to show them off, be innovative, creative, collaborative, and demonstrate your ingenuity.
5. A great 4-H attitude!—This is a fun chance to stretch your skills, see what other 4-H'ers are doing, and show off all the hard work you've put into the past year. Come ready to have fun and learn!

Odds and Ends

Attendance – When you registered for this event you indicated the number of team members attending. We understand that things happen, and a team who planned to attend may not be able to. If this situation arises, and you know in advance, please email Christine Wood at Christine.Wood@sdstate.edu so we can allow another team in.

Resources – Before the Event: if you have any questions or concerns contact Christine Wood at Christine.Wood@sdstate.edu. At the Event: we will have technical advisors to offer limited assistance with computer, programming, or component problems. Event staff will also be available to answer questions and clarify the challenges. We want you to have fun, learn something, and discover the amazing things you can do. We will do everything possible to make this fun and educational while keeping the playing field level. So, if you have a question, ask!

Robot Specifications – Both divisions require the use of an autonomous robot. This means robots should be programmed to run the course without any type of human intervention, so no push button commands, Bluetooth, or remotes may be utilized.

Role of the Adult Leader/Coach – This is the kids' event! Thank you for all the hard work you do to make these amazing experiences and learning opportunities available to 4-H'ers. Now is the time to watch with pride as they once again put it all together and show their stuff. You're here to supervise and provide guidance and encouragement from your coach's box. Let's watch them shine!

Safety – We expect everything will go smoothly and safely. No injuries, no accidents, nothing that a hug or a bandage couldn't remedy. However, as a leader you have to be aware of your responsibilities for the care and safety of your team members, their belongings, those around you, and the facilities. It starts when you get behind the wheel and doesn't end until the last team member is safely home. There will be a lot of valuables sitting on tables around this event. The State Fair Grounds are a busy place, and there will be many people in and out of the building and spectators watching the teams work and cheering them on during the Challenge Events. Use common sense. Don't leave valuables unattended. Establish and encourage rules for your team before you arrive. Keep your team members and their belongings safe.

4-H Robotics Contact Information

Christine Wood – Robotics Committee Advisor

SDSU Extension 4-H Science Technology Engineering and Math Field Specialist

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Please contact us with any questions or concerns.

Appendix A – Autonomous Challenge

Autonomous Challenge (Recreational and Competitive) – Parking Lot

Mission:

Refer to Appendix A Figure 1

The robot must move cars from their start position into either the red or blue scoring area.

Rules:

- Cars may be picked up or pushed but the robot can only carry and/or push one car at a time. For example a robot can use a claw to carry one car while pushing another with a plow, but cannot carry more than one car at a time or push more than one car at a time. If the robot does carry more than one car or push more than one car into the scoring zones, none of those cars will be scored.
- This course has two minutes to score as many points as possible. The scoring will end before two minutes if:
 - The team indicates their robot's programming is done.
 - The team incurs a touch penalty.
 - The robot plays music signifying completion of robot's run.
- Each car can score points twice (once for each scoring area).
- To score a car, the car must be fully in the red or blue scoring area (the width of the border is included in the scoring area) and not touching the robot.
- A car that is scored in the blue scoring area does not automatically count as being in the red scoring area.
- Cars touching cars that are touching the robot do not count as separated from the robot and are therefore not able to be scored

Scoring

Table 1. Recreational Challenge – Parking Lot (Figure 1)

Task	Points
Large (Red) Square Block	300
Inner (Blue) Square Block	500
Play Music at End	500
Restarts (per occurrence)	-100
Touching of the Robot	DQ, no score

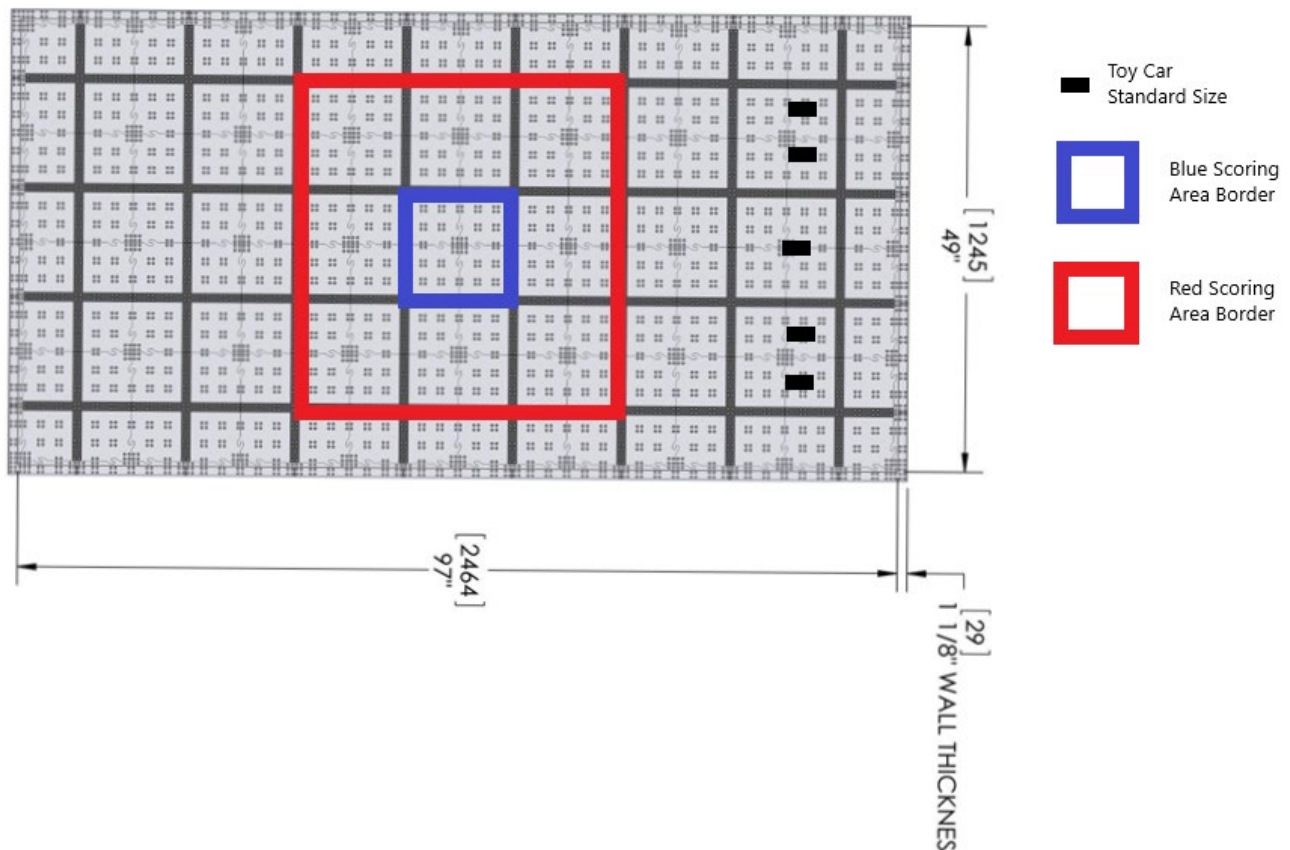


Figure 1. Recreational Challenge – Parking Lot

Skills to Build:

Critical Thinking/Strategy – As with any competitive game, having a good strategy will make the difference when it comes to scoring. Begin by reading the challenge and mission steps. Then re-read them and ask yourself:

- What is the overall goal of the challenge?
- Are all tasks listed necessary to achieve the goal? If not, what steps are necessary to achieve the goal?
- What are the constraints? (Can you cross walls?, Are you limited on where you can start/finish?, Is there a maximum amount of time?, other?)
- Which of the necessary actions are worth the largest point values?

Once you have answered the above questions, identify your team’s strategy for accomplishing the goal and maximizing your score.

Creative Thinking – The ability to think outside of the box is one of the greatest assets when it comes to developing a strategy. Just because a solution appears to be obvious, it may not be the best strategy for both accomplishing the goal and collecting the most points. Explore ways to be creative in developing a game strategy, in your robot build, and in your programming.

Collaboration – An essential part of any team, is being able to work together to solve problems, plan solutions, allocate tasks, and perform tasks. All individuals should be actively engaged in all portions of the challenge.

Computer Programming - Basic programming can be utilized for this challenge. Robots may need to move forward, backwards, and make various turns. Robots will also need to be able to lift, move, and release objects to be successful.

Appendix B – Junk Drawer Challenge (Recreational and Competitive)

Challenge – Get the Package Delivered!

Mission

Refer to Appendix B Figure 2

Your team must create a Junk Drawer Robot out of the materials provided to deliver a package (2 inch cube) to the floor that is specified in the diagram within two minutes. The package may begin loaded on your robot but must be within four inches of the ground. The package has to remain on the floor after being delivered. Packages falling off do not count towards the score.

Scoring will end when the package is successfully delivered, a total of 2 minutes have elapsed, or the team declares verbally that they are done.

Rules

1. You may only use materials provided in the Junk Drawer
2. Jr and Sr Competitive Divisions must complete the Junk Drawer Notebook
3. For challenges with a defined start area, you may choose anywhere in the start area to start
4. If your robot fails to move, stops, tips over, or gets stuck, you may rescue your robot and attempt to fix the problem, but your robot will incur a 'touch penalty'
 - a. Touch Penalty: If your machine just needs a little nudge or wiggle to continue on its way, but you don't want to do a restart, you can take a touch penalty instead.
5. Restarts: If your machine fails to start, gets stuck, tips over, goes astray or needs to be reoriented, moved or in any other way rescued, you may attempt to fix the situation and restart your machine, but
 - a. Your timer will restart the clock 30 second clock but not the overall running clock.
6. The playing area may not have anything affixed to it from your junk drawer.
7. Your machine must take a minimum of 5 seconds and a maximum of 30 seconds to complete the challenge
8. The countdown will not begin until the judge says "Go".
9. If restarts force an overall time of 2 minutes the round will be immediately over and no more points can be earned.
10. Only two members of your team may be in the competition area during the round. They must remain behind or to the side of your machine.
11. Quantities of materials in each team's junk drawer are identical
12. A few supplies are limited to the number provided in the kit, however you are permitted to request more of any item. If such requests can be granted without creating an unfair advantage, they will be.
13. Make requests for additional supplies to the technical advisors
14. Report broken motors and dead batteries to technical advisors for replacement.
15. Your team will get one attempt to accomplish the mission.

Scoring

Table 2. Scoring Junk Drawer Challenge – Get the package delivered (Figure 2)

Task	Points
Deliver Correct Package	1500
Touch Penalty	-50
Restart Penalty	-100



Each Cube is 6 inches and has open sides and should contain a floor on each level.

Red Level: Recreational Scoring Floor Zone

Blue Level: Junior Scoring Level Floor Zone

Green Level: Senior Scoring Level Floor Zone

Figure 2. Junk Drawer Challenge - Get the package delivered

Potential Junk Drawer Materials

(Items listed will be available but additional items may be added the day of the contest)

- | | | |
|---------------------|--------------------|---------------------|
| - Gears | - Scissors | - Electrical Tape |
| - Paint Sticks | - Heavy Duty Punch | - Hand Miter Box |
| - Straws | - Wire | - Pulley |
| - String | - Wirecutters | - Dixie Cups |
| - Motor w/batteries | - Pliers | - Balloons |
| - Hand Drill | - Popsicle Sticks | - Coffee Stir Stick |
| - Hot Glue | - Solder | - Wood Shims |

Skills to Build:

Time Management – Teams are given 2.0 hours to complete BOTH the autonomous and junk drawer portions of the competition. It is up to them to determine how they want to allocate their time.

Critical Thinking/Strategy – As with any competitive game, having a good strategy will make the difference when it comes to scoring. Begin by reading the challenge and mission steps. Then re-read them and ask yourself:

- What is the overall goal of the challenge?
- Are all tasks listed necessary to achieve the goal? If not, what steps are necessary to achieve the goal?
- What are the constraints? (Can you cross walls?, Are you limited on where you can start/finish?, Is there a maximum amount of time?, other?)
- Which of the necessary actions are worth the largest point values?

Once you have answered the above questions, identify your team's strategy for accomplishing the goal and maximizing your score.

Creative Thinking – The ability to think outside of the box is one of the greatest assets when it comes to developing a strategy. Just because a solution appears to be obvious, it may not be the best strategy for both accomplishing the goal and collecting the most points. Explore ways to be creative in developing a game strategy, in your robot build, and in your programming.

Collaboration – An essential part of any team, is being able to work together to solve problems, plan solutions, allocate tasks, and perform tasks. All individuals should be actively engaged in all portions of the challenge.

Pulleys – Explore various pulley designs and how they can be utilized to lift a load.

Pneumatics/Hydraulics – Explore how fluids can be used to create motion and move objects as needed.

Junk Drawer Robot Design / Engineering – Points 600 (Jr. level) or 800 (Sr. level)

Criteria				Points
50	100	150	200	
Design shows little to no creativity	Design has some creative aspects	Design is creative	Design is very creative	_____
Design is inefficient or uses an excessive number of parts	Design is somewhat efficient	Design is efficient most of the time	Design is efficient all of the time	_____
Team has little to no knowledge of why some parts are located as they are on the robot or what they do	Team shows minimal knowledge of the robot design	Team shows moderate knowledge and understanding of their robot design	Team can thoroughly explain the design of their robot	_____
Team spent more than 10% over their budget*	Team spent more than their budget, but was less than 10% over*	Team was able to stay on budget but with no remaining funds*	Team was able to stay on budget with remaining funds*	_____*

*Sr. Division teams will be required to manage a budget in addition to building their robots. This part of the rubric is for those teams only

Appendix C – Additional Scoring Rubrics

4-H Values – Total possible points 800

Skills	Criteria				Points
	50	100	150	200	
Participation – All members take an active part of the team effort	Rarely	Some of the time	Most of the time	All of the time	_____
Teamwork – It is clear that the team works together as a unit	Rarely	Some of the time	Most of the time	All of the time	_____
Respect/Sportsmanship – Team members are knowledgeable of and follow all rules involving Challenge Day. Students show respect to all participants.	Rarely	Some of the time	Most of the time	All of the time	_____
Integrity – Coaches, parents, or other adults offer assistance, but the students are CLEARLY doing the work among themselves	Rarely	Some of the time	Most of the time	All of the time	_____
Engineering Notebook – Records are kept in the notebook and provides a clear picture of the robot design process and programming process	Rarely	Some of the time	Most of the time	All of the time	_____

Engineering Design – Total possible points 1200

Criteria				Points
50	100	150	200	
Design shows little to no creativity	Design has some creative aspects	Design is creative	Design is very creative	_____
Design is inefficient and ineffective	Design is either inefficient or ineffective	Design is efficient and effective at completing most tasks	Design is efficient and effective at completing all tasks	_____
Program shows little to no creativity	Program has some creative aspects	Program is creative	Program is very creative	_____
The program is ineffective	Program is effective at completing some tasks	Program is effective at completing most tasks	The Program can complete all tasks	_____
Team cannot explain robot and program design	Team cannot explain robot or program design	Team can mostly explain robot and program design	Team can fully explain robot and program design	_____
Team has no records of their design method (engineering notebook)	Team has limited records of their design method (engineering notebook)	Team has complete records of most of their design method (engineering notebook)	Team has complete, records of all of their design method (engineering notebook)	_____

Total Points _____

Appendix D – Frequently Asked Questions (FAQ)

General Challenge Questions

What do we use for a challenge board?

The challenge course is 4 ft. x 8 ft. It can be constructed on any smooth surface including but not limited to plywood or the floor.

The State 4-H program has purchased VEX IQ boards to be utilized at the State Fair: <https://www.vexrobotics.com/iq-field.html>. Purchasing this board is NOT a requirement and is NOT necessary for your team to be successful.

Does the challenge have walls on the outer perimeter?

Yes. The outer perimeter of the board has a 2.5 in. tall wall. The wall does not encroach on the 4 ft. x 8 ft. challenge area.

How do we set up the challenge board?

The dimensions and placement of the challenge obstacles can be found in each individual challenge allowing teams to build a practice board and develop their base program. Keep in mind that the challenge at the State Fair will be considered a modified real time challenge.

What is a ‘modified real time challenge’?

A challenge that is modified in real time, is one that requires the teams to make adaptations to their programs to account for minor changes made to the challenge or to account for environmental changes. For example, the challenge may be modified to account for a tower that is lost or broken in transport. In this case, the tower may either be removed or the tower dimensions may be changed. Additionally, the environment in which teams practice will NOT be the same as the environment the day of the challenge. Youth need to be able to adapt their base program to accommodate for things like challenge surface, lighting, noise, or otherwise.

What is the difference between a touch and a restart?

A touch is anytime contacts (nudges, pushes, pulls, etc. but not lifts) are made with the robot in order to slightly alter the direction of the robot or the objects being carried by the robot. Lifting the robot from the table is NOT a touch and will signify the end of the robot’s run.

A restart is when the youth intentionally indicate to the judge that they will be resetting their robot and starting the run over. Once this is indicated all previously earned points will be voided and the robot scoring will begin again. A restart may occur if the robot/machine fails to start, gets stuck, tips over, needs rescued, or reset.

Are we allowed to utilize expansion packs or add components not from the base kit to our robot?

Yes. Robots are required to be autonomous; however, there are no specifications on how they must be constructed.

Can we utilize something other than a LEGO MINDSTORM robot?

Yes. The challenge is written for an autonomous robot. This means that any robot that can be programmed to complete the challenge without a remote control can be utilized.

Can we utilize more than one robot?

Only one robot will be allowed on a single challenge board. Teams may not change robots mid-run. Teams should have their robot constructed to be able to complete all tasks they plan to attempt.

4-H Robotics Challenge Registration

Due: August 10th, 2021

Email Forms to:
Christine Wood – christine.wood@sdstate.edu

County _____

Team _____

Coach _____ Phone Number: _____

Email _____

Team Member	Age	4-H Member?
1.		
2.		
3.		
4.		
5.		

Division? Recreational (What type of robot will you be bringing _____)
 Competitive

Team _____

Coach _____ Phone Number: _____

Email _____

Team Member	Age	4-H Member?
1.		
2.		
3.		
4.		
5.		

Division? Recreational (What type of robot will you be bringing _____)
 Competitive

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