South Dakota State University Extension

2024 South Dakota 4-H
Robotics Showcase

Showcase Overview

The South Dakota 4-H Robotics Challenge Showcase is an opportunity for youth to demonstrate their knowledge and mastery of robotics. During the showcase, youth will share the robot challenge that they designed as well as the robot they built and programmed to complete the challenge.

Event Location

The event will be held Friday, August 30, 2024 on the South Dakota State Fairgrounds, Huron, SD. The challenge will be held in the Nordby Exhibit Hall on the State Fair Grounds.

Schedule*

8:00 a.m. – Check in for Group 1
8:45 a.m. – Group 1 judging*
10:00 a.m. – Check in for Group 2
10:45 a.m. – Group 2 judging*

This schedule is tentative and subject to change based on facility capacity and number of teams.

*Judging length will depend on how many teams are registered per session.

Eligibility

1. Registration is taken on a first-come-first-serve basis through **August 13, 2024**. This registration deadline will be strictly enforced.
2. Youth may register as individuals or as teams.
3. Teams may consist of youth from different counties.
4. All participants must be currently enrolled in 4-H and at least 8 years of age by January 1, 2024, but not have turned 19 years old prior to January 1, 2024.

Robotics Course Design Challenge

Youth have been tasked with designing their own robotics course. Youth will bring three deliverables to the State Fair: Challenge Booklet, Challenge Board, and Robot. Upon registration, teams will indicate the time they prefer to present their course during the State Fair. Teams will have 45 minutes after check in to set up their challenge boards and finesse their robot program. Teams will then take turns presenting their challenge and demonstrating how their robot completes the challenge.

Challenge Booklet

Within their challenge booklet, youth will indicate if the course is designed for a beginner, intermediate, or advanced audience. The storyline, tasks, and scoring will be outlined in the booklet as well. Junior and senior members will also be asked to include a list of skills that are mastered in completion of the course (example: youth who master this challenge successfully incorporate the wait block, or youth who master this challenge will successfully use the medium motor to move a block). For more ideas on what mastery looks like, see the FIRST® LEGO® League Robotics Skills guide in Appendix A.

Robot

Youth will need to bring a robot designed and programed to complete the challenge they have designed. ANY robotics platform may be utilized.

Challenge Course

Youth will need to bring everything they need for their course. This includes all obstacles and the board itself.

Requirements

- Course maximum size is 4’ x 6’
- For Senior members the course and robot should make use of at least 2 sensors. It is highly encouraged that

Juniors also use sensors. For Beginners, sensor use is optional.

- Course must include the movement of at least 2 objects

Contacts

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Judges Scorecard

Criteria	Needs Improvement (1 point)	Average (2-3 points)	Excellent (4-5 points)
Course – How unique and creative is the robotic course? Does it use unique challenges or obstacles? Is the course appropriate for the audience noted? Does the course fit within the storyline? (add 1 pt for Beginner and Junior teams using sensors).			
Storyline – Is there a story line with the robotics board? Does the course provide a background for the challenge as well as effectively outline the tasks that need to be completed. Does the course fit within a narrative?			
Robot Design – Is the robot design creative? Does it appear to address the challenges in the course? Does it use at least 2 sensors? Is the robot able to complete the course that it has been designed for?			
Scoring – Does the robot course have a scoring system? Does the scoring seem appropriate for the skill level of each task? Are their opportunities for points to awarded as well as taken away?			
Presentation – Are youth effective in sharing their course and the tasks that need to be completed? Are the 4-H youth able to answer questions from the judges? Are all youth aware of why decisions were made in the design process? If a team presentation, are all youth participating in the presentation?			
Mastery (Jr./Sr. Only) – Do youth list at least one skill mastered for each task of the robot challenge? Are the skills noted appropriate for the challenge level listed (example: a robot moving forward and backward is appropriate for a beginner, but not an advanced challenge)?			
Total:			

Beginner

Purple (20-25) _____ Blue (13-19) _____ Red (6-12) _____ White (<6) _____

Junior/Senior

Purple (24-30) _____ Blue (16-23) _____ Red (8-15) _____ White (<8) _____

The following is an example of a robot course design
Challenge 1 — Starkiller Base Trench Run

Scenario – Intermediate

Story Line

Before our attack on the Starkiller Base, we have been able to sneak you onto the planet. However, we can only risk you being on the planet for 3 minutes before you are detected. We have a list of tasks for you to accomplish and it is your goal to get as many of them done as possible. There is a canyon separating your landing zone from two of our objectives. Luckily, Bothan spies were able to mark a path that will safely lead you through the canyon. Good luck. May the force be with you!

Objectives (Figure 1)

1. Your mission objective is to complete as many tasks as possible within your 3 minute time frame. Those tasks are:
   a. Press the call button
   b. Follow the line through the canyon (top to bottom)
   c. Follow the line through the canyon (bottom to top)
   d. Disassemble the tower located at the bottom of the board
   e. Deliver the dish part of the tower to the storage location
   f. Collect a sample rock from the bottom of the board
   g. Deliver the sample to the lab location
2. If you complete at least three of the above tasks and return to the Start Box, the points for each task you complete will be doubled.
3. The call button is considered to be pushed if some part of the robot comes to rest on the button for at least 1 second.
4. In order to score points for either successfully delivering the rock sample or the tower dish, the object must be placed completely within its drop off zone.
5. A line sensor may be used to make it through the canyon but does not have to be used
6. The mission ends when either the timer reaches zero or your robot returns to the start location.
7. Your team will get one attempt to accomplish the mission.

Scoring

Mission Objectives	**Maximum Possible Points**
Press the call button	200
Follow the line through the canyon from top to bottom	300
Disassemble the Tower	400
Deliver Dish from Tower to Storage Zone	700
Collect a Sample (successfully pick up a rock)	200
Deliver Sample to Lab Zone	500
Follow the line through the canyon from bottom to top	300
2x Bonus for Completing 3 Mission Objectives and Returning to Start Box	2x Total Points
Additional Points Available	
Start in the Start Box (Launchpad)	100
Return to Start Box (Launchpad)	250

*Every human assist of the robot will deduct 5 points from final score
*Sr. Division Teams will be timed, the top time will receive an additional 10 points

Challenge Dimensions 4’x8’

- Each Grid Represents 6”
- Squares Containing Cliffs will have a 6” vertical face. These squares will have some percentage of them covered by a cliff.
- The black line is a flat line that runs the length of the canyon
- The blue and red box is a flat surface

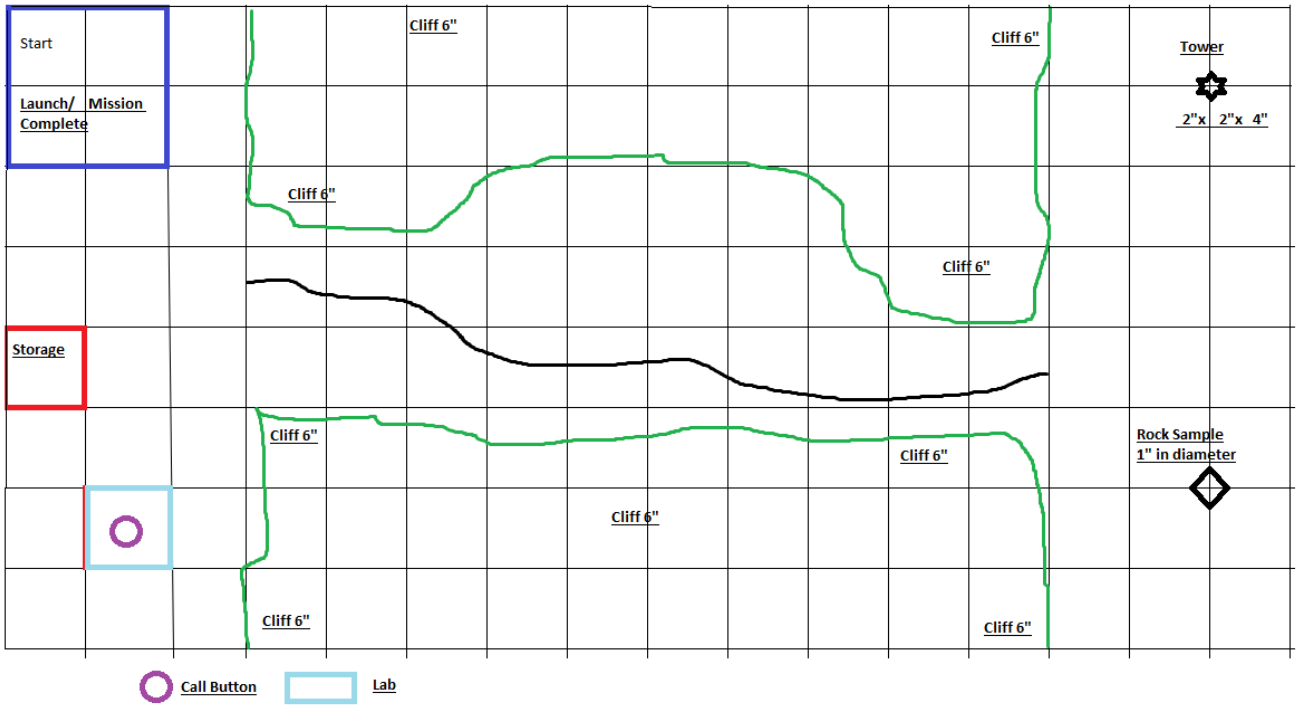

Figure 1 – *Grid is 6 in. squares

Appendix A – FIRST® LEGO® League Robotics Skills

FIRST® LEGO® League Robotics Skills

By Jeremy Haugen (South Dakota FLL Partner) with help from the Share & Learn Community

Introduction – This list represents the experience of countless coaches, judges, and tournament organizers as to about when these specific skills develop. It is presented in a general progression of easier or fundamental skills in 1st year, and each year generally builds on the one before it.

By no means should the list below be seen as a checklist of skills that a team needs to possess at certain milestones to be 'successful'. Skill development should be driven by the interest and needs of the team. Team X, for instance may completely skip the color sensor in favor of focusing on the gyro due to their robot build, the nature of the missions that they want to tackle a certain year, or just because they like how the gyro works. **Please don't use this as a 'robot curricula'.**

How to Use this

- Use this as inspiration. This list gives you a bigger picture of what the robot is capable of. Teams may not know that an alignment jig is possible or that color sensors can be used to follow lines, but this document can let them know what to search for.
- Use this when teams get stuck … if a team is struggling with a Proportional Line Following program, make sure that they have mastered some of the lower level skills.

Robotics Programming Skills

First Year (notice, how you build your robot will determine if these are easy or hard. Try using the basic build suggested from LEGO [without attachments] before working on your own designs.)

- Driving straight forwards a set distance
- Driving straight backwards a set distance
- Use different motor settings (degrees, seconds, on, off, etc)
- Turning right 90 degrees
- Turning left 90 degrees
- Using a loop to drive a square (same length sides, same angle corners, and returning to the point at which you started).
- Program an attachment to move in 2 directions (up and down, etc)
- Explain how the color sensor works, including its limitations
- Simple line detection using a color sensor
- Simple line following using a color sensor
- Commenting on Code

Second Year

- Using Boolean logic (if, then, else … wait until, etc.)
- Change robot speed within a single program
- Use inequalities in programming
- Use math functions in programming
- Proportional Line Following
- Explain how the Gyro Sensor works, including its limitations
- Turning 45/90/180 degrees using a gyro sensor
- Explain how the Ultrasonic Sensor works, including its limitations
- Simple object detection using Ultrasonic Sensor

- Wall following with the Ultrasonic Sensor
- Making and maintaining an Engineering notebook... with an emphasis of the Engineering Cycle, and the changes of the code over time.

Third Year
- Use Variables in Programming
- Use MyBlocks in Programming
- Using Broadcasting to control timing, etc
- Using multiple color sensors to square on a line
- Using multiple color sensors for line following

Robotics Building Skills

First Year
- Explain how tire size changes how a robot moves (Speed, torque, traction, and clearance)
- Building light, but strong structures and attachments (Triangles, angled beams, etc)
- Building techniques that change the orientation of the holes in a beam
- Design and build an attachment that doesn't need a motor (pushers, latches, levers, droppers etc.)

Second Year
- Explain how the concept of center of balance changes how a robot moves
- Using gears to transmit power from one place to another
- Using gear ratios to increase speed or increase torque (not both!)
- Using gears to change the orientation of a motor's rotation (using gears that mesh at 45 or 90 degrees)
- Quick attach/detach methods
- Interchangeable powered attachments (switchable attachments powered by a single motor attached to the robot, not the attachment).
- Making and maintaining an Engineering notebook... with an emphasis of the Engineering Cycle and changes to the robot and attachments over time.

Third Year
- Multiple attachments activated in sequence, using a single motor (for example, using a cam system or differential to activate different attachments in sequence)

Robotics Game Strategy Skills

First Year
- Squaring using a table wall (backing the robot into a wall to make sure that you are perpendicular to the wall.)
- Using alignment Jigs to increase the speed and repeatability of robot placement
- Evaluate missions on
  - Ease of navigation
  - Ease or type of activation

Second Year
- Eliminating Variables (such as battery charge level, attachment placement, or robot placement)
- Beating Murphy's Law (ie, make it so that it cannot mess up. Ie, making East Launch Zone jigs and attachments the same color while the West Launch Zone jigs and attachments are a different color)
- Building multiple designs of robots, and evaluating them for the missions
- Doing multiple Missions per program/run
- Documenting repeated tests prior to adjusting code or Robot build (ie, did you repeat Mission X 10 times before changing the code? How many of those times was the mission successful? Where in the code does the robot begin to fail?

Appendix B – Registration

4-H Robotics Challenge Registration
Due: August 13, 2024

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

County: _____

Team: _____

Coach: _____ Phone Number: _____

Email: _____

Team Member	Age
1.	
2.	
3.	
4.	
5.	

Please mark your preference for judging time:

_____ 8 am

_____ 10 am

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