RDL JR

2024 CHALLENGE

2024 Official Challenge Rules and Guide

Laws of Robotics

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.

2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

~Isaac Asimov

And one more….

4. A robot may not intentionally injure another robot unless the action or inaction conflicts with the First, Second or Third Laws. ~ Scooter Willis (Creator of RDL)

To the teachers who passionately lead the entire future of our world from their classroom….~ Thank You ~

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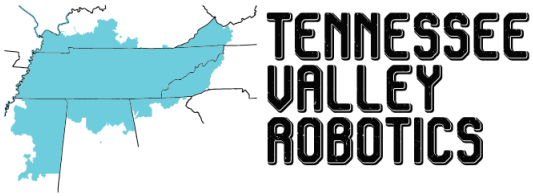

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Introduction

Creativity and innovation are key elements to advancing the fields of science, technology, engineering and mathematics (STEM) into the future. Robot Drone League (RDL Jr) Junior has been designed to provide younger students with open-ended challenges that allow for creation and innovation by engaging in hands-on design, engineering, and programming of interactive robots and drones. Students are presented with the opportunity to develop real-world connections to classroom learning. Working with robots in a collaborative game format can be a very powerful tool to engage students and enhance math and science skills through hands-on, student-centered learning. Through participation in RDL Jr., students develop the essential, early-on, life skills of teamwork and collaboration, as well as critical thinking, project management, and communication required to become the next generation of innovators and problem-solvers in our global society. The 2024 RDL Jr. “MINESHAFT" challenge, presented by STREAMWORKS, is designed to inspire younger students to develop a lifelong passion for learning and pursue educational and career opportunities in STEM fields by implementing real-world STEM-related problems that require innovative and critical thinking to find solutions.

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Please visit www.robotdroneleague.com

You can follow us on Twitter @PhotonProfessor.

Like us on Facebook at STREAMWORKS / PROFESSOR PHOTON

Dear RDL Jr. Participants, Supporters, and Enthusiasts,

Welcome to the Robot Drone League Jr. (RDL Jr) 2024 Challenge, MINESHAFT. This year, we embark on a remarkable journey that not only showcases the innovative spirit of RDL but also pays homage to a significant chapter in the American narrative—the history of coal mining in the Appalachian region.

The Appalachian mountains, home to vast coal deposits historically dubbed as "black diamonds," have played a pivotal role in shaping the economic and social landscape of the Southeastern United States. From the late 19th to the early 20th centuries, these resources fueled the rapid industrialization of post-Civil War America, transforming local economies and attracting a diverse workforce. However, this boom was not without its cost, bringing about harsh labor conditions, health risks, and ecological challenges.

Today, as we witness a shift in energy sources and economic paradigms, the decline of traditional coal mining presents an opportunity to reflect on its legacy. The MINESHAFT challenge is not just a competition; it represents a platform for innovation and education. Through this initiative, we aim to leverage modern technology to address both past and present challenges, exploring innovative solutions such as biomining. This technique offers a sustainable method for extracting valuable materials, minimizing environmental impact, and promoting the restoration of ecosystems affected by traditional mining practices.

Our robots and drones are more than just tools for exploration and competition; they symbolize our commitment to understanding the impacts of industrial activities and innovating towards sustainable and safe practices. As STREAMWORKS champions the fusion of Science, Technology, Robotics, Engineering, Arts, and Mathematics, we are molding a skilled, knowledgeable, and adaptable workforce. This initiative embodies our dedication to transforming educational experiences into practical, real-world applications.

Through this challenge, participants will gain invaluable insights into the complexities of industries like mining while contributing to technological advancements that promise safer, more efficient, and environmentally responsible practices.

Let us move forward with the spirit of innovation and collaboration, honoring the rich history of Appalachia, while paving the way for a future where technology and tradition merge to create sustainable solutions for the challenges of yesterday, today, and tomorrow.

Thank you for joining us on this exciting journey, and let the 2024 RDL Jr MINESHAFT challenge begin!

Sincerely,

Taylor Burgess

Taylor Burgess
Boys and Girls Clubs of Central Appalachia | CEO
STREAMWORKS Education Executive Board Member

Challenge Overview

RDL Jr. 2024 Challenge: MINESHAFT

For the 2024 challenge, named "MINESHAFT," we're elevating the Robot Drone League Jr. game by focusing on the innovative integration of robotics and drone technology within an immersive mine exploration theme. This challenge is designed to highlight real-world applications of machine control, navigation, and gaming strategy, emphasizing teamwork, effective communication, and diligent practice as pathways to achieving the highest scores.

In the "MINESHAFT" challenge, teams of 2 to 4 students will take on the role of mine explorers at a specially designed control station. Their mission is to navigate through a simulated underground environment to collect valuable resources, formerly known as pucks and cubes, from the rival team's territory on the RDL Jr. challenge field. This task will put their skills to the test as they demonstrate mastery over the robot and drone, maneuvering through intricate mine shafts, following tracks, executing precise stops and starts in designated zones, triggering interactive beacons, and performing complex aerial maneuvers to overcome obstacles.

This year's "MINESHAFT" challenge offers students the unique opportunity to engage hands-on in the construction and programming of a robot and drone, honing their abilities to execute flawless movements and tackle field challenges without direct intervention from mentors. Collaboration is key as team members work together to devise strategic plans for collecting scoring resources while solving math and science puzzles for additional competitive points.

The "MINESHAFT" challenge reinforces the significance of programming skills, with a special emphasis on the use of drones' image sensors. Teams are encouraged to leverage this technology for solving STEM-based challenges presented on field monitors, integrating practical problem-solving with advanced technological applications.

By incorporating the Next Generation Science Standards (NGSS), the "MINESHAFT" challenge ensures that participants are not only engaging in a competitive and educational experience but are also answering grade-appropriate science and math questions, making the journey through the mines a comprehensive educational adventure.

Game Rules

Object of the Game

For the 2024 "MINESHAFT" challenge, the objective has been reimagined to capture the essence and excitement of subterranean exploration and resource recovery within a competitive and technologically rich environment. Here's how the game is structured:

The core mission of "MINESHAFT" is for teams to efficiently navigate a robot and drone through a simulated mine environment, completing a series of tasks designed to mimic the challenges of real-world mine exploration. Teams have a five-minute match to score as many points as possible. The initial sixty seconds of each match are dedicated to autonomous operations, where teams demonstrate pre-programmed maneuvers without manual control, emphasizing the importance of advanced coding and strategic planning.

The game is set in 487.68 cm (192.00 in.) by 487.68 cm (192.00 in.) indoor field, resembling a network of mine tunnels and shafts. This field is divided into two mirrored halves, with teams designated as either the red or blue alliances to compete against each other. Each alliance's side is dotted with obstacles and opportunities, including valuable mineral resources (represented by fluorescent color coordinated gaming cubes and balls) that must be collected and transported to a designated scoring zone.

In the "MINESHAFT" challenge, teams must navigate their terrestrial robot across rugged and uneven terrains, symbolizing the hazardous conditions found in mines. These terrains are marked with various colored blocks to assist in autonomous navigation. During the autonomous phase, robots and drones must independently traverse these terrains and overcome obstacles, showcasing the teams' programming acuity.

The drone's role is significantly expanded in this challenge. It must perform successful take-offs and navigate through a complex aerial environment, including executing precise landings, maneuvering through confined spaces, and collecting biomining game elements and affecting the coal deposits by inserting bioming elements into the payloads. Teams are also tasked with solving STEM-related questions displayed on monitors within the field, adding a layer of intellectual challenge to the physical competition.

Teams accumulate points by successfully completing robotics tasks, collecting resources, completing aerial challenges, and answering STEM questions. The game encourages not only technical skills in robotics and drone piloting but also critical thinking and teamwork, as alliances strategize to maximize their score within the five-minute timeframe.

The "MINESHAFT" challenge, with its emphasis on autonomous capabilities, drone technology, and STEM integration, promises an engaging and educational experience for participants, fostering skills in programming, engineering, and scientific inquiry.

Matches

Teams will compete in scoring matches in which teams are randomly assigned to an alliance drive station and will compete for the highest score on the field. The first minute requires robots and drones to operate autonomously. This is followed by a four-minute teleop period of robots and drones operated under the control of the humans. Practice matches will be allowed if time permits.

Starting Position

Robots and drones are to be placed in the starting position prior to beginning the match. The starting position is marked by three adjacent 61.0 x 61.0 cm / 24.0 x 24.0-inch yellow squares, positioned directly in front of the assigned driver's station. Robots and drones may start from any orientation or positions with adaptive elements (Velcro, magnets, hooks, etc.) while in the yellow start / stop areas. Alignment tools and devices are allowed onto the playing field, (starting zones only!) as long as the tools do not interfere with the ability of the opposing alliance to retrieve game elements and score points.

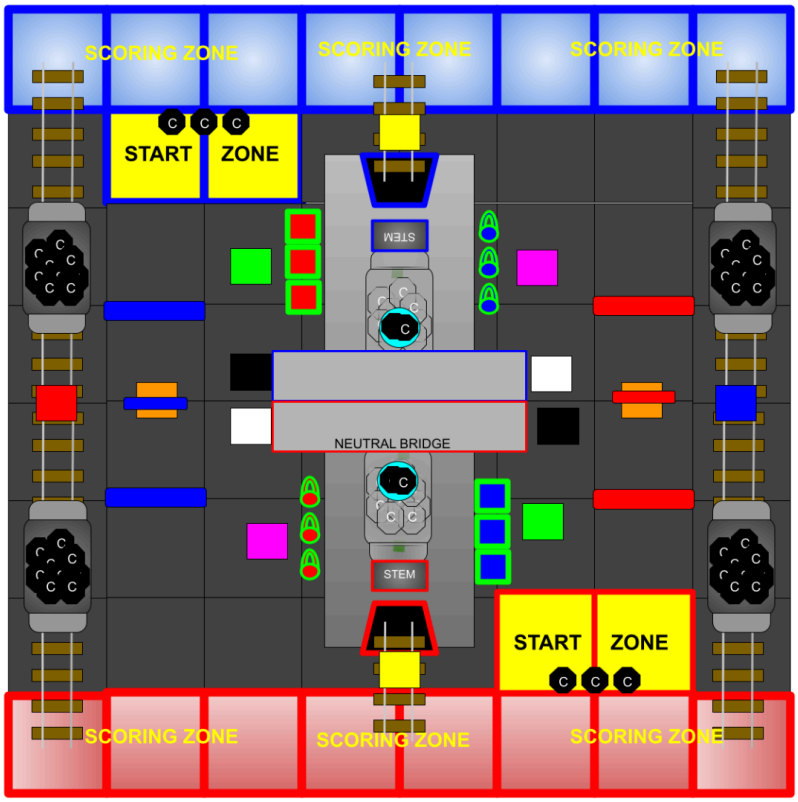

Figure 1: RDL Jr. Field, Birds Eye

Three coal (C / Carbon w/biomining catalyst) gaming elements are set in the starting zone. Teams are allowed to start with one gaming element set in control of the robot or drone, with the intention of attempting to score in both the autonomous and teleop periods.

Yellow Start / Stop Area

For each alliance side, there is a designated area for start and finish of the robot and drone and is adjacent to the assigned drivers station. Two yellow colored field mats are 60.96 cm / 24 in. each and will be utilized for all starts, stops, and resets for drone and robot during the 5-minute match period. All scoring elements must be successfully delivered back to the alliance (Red / Blue) mats which is also considered the scoring zone. IUnless approved by the event coordinator, the RDL Jr. field official is the only human allowed on the field at any time and within the Yellow Start / Stop Area.

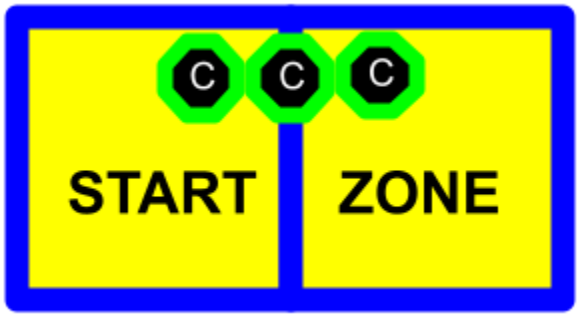

Figure 2: Start / Finish

Aerial Rings

The RDL Jr. field has three rings located in the center of the field. The Outer RDL logo rings measure 48.00 in. / 121.92 cm in diameter and the center Blue or Red ring measures 24.00 in. / 60.96 cm. Teams are awarded points with each successful passing through of each ring and activating the beacon lights. Teams are allowed additional points during the match as long as the beacons have reset to the off condition, (usually within 30 seconds). With exception of autonomous mode, drones must first pass through the larger ring located at the furthest distance from the drivers' station and then travel through the smaller center ring, and then exit the stunt zone through the larger colored ring. For example, the Red Alliance driver station drone must pass through the RDL Jr. ring furthest from the corresponding driver station first when attempting a ring fly through and /or aerial stunts within the stunt zone, and then pass through the corresponding-colored ring, Red or Blue, at midpoint, and then complete the ring course by passing through the RDL Jr. ring last in one continuous and interrupted flight. Teams are not permitted to repeatedly pass through one single ring on any given attempt unless the drone has been reset in the yellow start / stop zone. Teams attempting to perform aerial stunts with the drone must pass through all three rings successfully

during a single attempt in order to receive any attempted aerial stunt scoring points. In the event of a drone crash, the RDL Jr. field official will perform an immediate “drone rescue” and reposition the drone at the teams assigned yellow mat start / stop area for any subsequent relaunch.

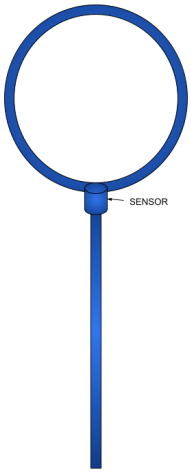

Figure 3: Aerial Ring

STEM Questions

Each team is given the opportunity to earn points by solving one (1) STEM-based question that appears after the match has started. During a 5-minute match, there are a maximum of ten (10) additional questions to be gained by each alliance. Teams are encouraged to attempt all questions by reading in front of the assigned alliance display and correctly answering the questions.

STEM questions are aligned with NGSS, Common Core, ISTE, and P21 Standards, individual state standards where applicable and are directly correlated to what students learn in the classroom.

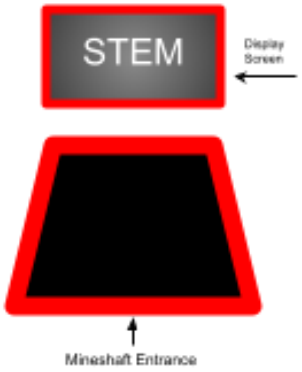

Figure 4: STEM Displays

Biomining Catalyst Elements

On the field, there are twelve (12) biomining catalyst elements located adjacent to the base of the mineshaft, nearest the neutral bridge. Each game element has either Velcro tabs affixed (loops), hooks, and / or magnets to the sides and / or loop rings to aid teams with element collection or delivery into scoring zones. RDL Jr. will provide additional Velcro (hooks) at competition. Upon team check in at the drive team station, the team captain must alert the RDL Jr. field official if certain implements need to be affixed to the game scoring elements prior to the beginning of the match, i.e. hook. Teams must first attempt to retrieve the elements of the assigned alliance color during the first 4 minutes of each match. During the first minute of each match, robots and drones must attempt collection or delivery of game elements in autonomous mode only, also referred to as the autonomous period. Teams are allowed to pre-load a Coal (C-Carbon) game element either into the robot or drone prior to the start of the match.

During the final one minute (1) of the match, teams are allowed to collect any unclaimed gaming elements on the challenge field, including the moving of coal carts into the assigned alliance scoring zone. For example, the Red Alliance team must initially attempt to retrieve the red elements from the opposing side field. After four minutes have expired in a 5-minute match, the Red team is allowed to retrieve any gaming elements that remain on any part of the field of play, except in the scoring zones. Gaming elements retrieved and placed in the scoring zone area of each alliance are considered scored points and no longer in play.

Figure 5: Biomining Catalyst Elements

TVA Dam Bridge

Two bridges connect the red and blue alliance sides of the field. Robots are permitted to traverse the bridges during all phases of each match. The bridges are identical in terms of terrain and difficulty. If a robot falls from the bridge and is unable to regain functionality, the RDL Jr. field official will recover the robot and reset it in the START / FINISH area. Teams are allowed to reattempt traversing the bridge an unlimited number of times during the 5-minute match.

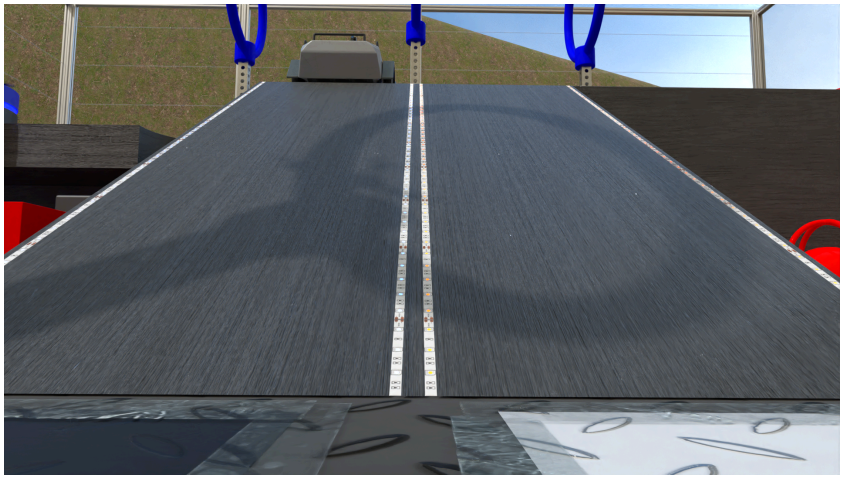

Figure 6: TVA Dam Bridge

Beacons, Coal Chutes and Carts

On the field, there are two (2) beacons, atop the MINESHAFT mountain, that can only be activated by a close proximity drone fly over in which colored LEDs will illuminate the neutral bridge to the applicable color. Teams are awarded points for both capturing the beacon and illuminating the bridge. Bonus points are awarded for a team that can capture the beacon and be in the initial motion of gaining access to the bridge and continuing to cross over the bridges mid-point enroute to the other side and while its alliance color LEDs are illuminated (@ = 30 seconds). This is referred to as a “beacon bridge capture”. Upon capture, the beacon will illuminate with the corresponding assigned alliance color, either Red or Blue. During the final one minute of match play, an opposing drone is allowed to fly into the opposing player's air space and attempt a beacon capture. Drones are allowed to recapture beacons during regular match play for as long as the LEDs remain illuminated (>=30 seconds). Drones may not make contact with any other drone or robot during any flight operations. Intentional contact will result in penalties and point reductions from the final match score. Please note there are a few regionals that do not have beacon equipment and will often utilize red or blue balloons, each scoring event recorded upon drone contact.

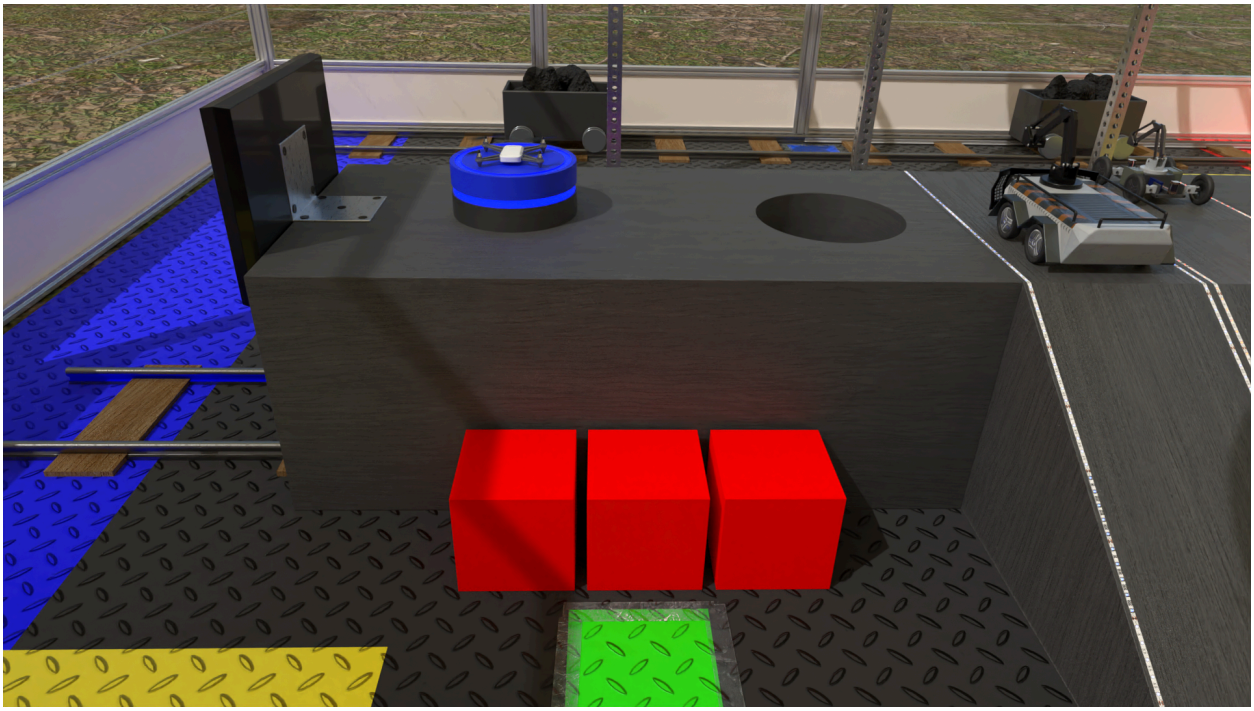

Figure 7: Beacons and Chutes

Autonomous Period

At the beginning of a 5-minute match, the first 60 seconds is considered the autonomous period. Human control of the robot or drone is not allowed. Teams are awarded points for autonomous movement of the robot or drone as depicted in the scoring table below. Drones and robots may score autonomous points independent of each other. Completing tasks autonomously (during the autonomous period) results in maximum points. During the autonomous period, teams are not allowed to modify their code or run their programs multiple times. Programs initiated must be completed upon initiation or one press of the “start button.”

Autonomous – 01:00 minute	***Action***	***Element***	***Robot/Drone/ Lab***	***Points Each***
	Movement beyond the starting block area	*Field*	*Robot*	***100***
	Movement beyond the starting block area	*Field*	*Drone*	***100***
	Image Recognition	*Field*	*Robot / Drone*	***400***
	STEM question	*#1 STEM Question*	*Human*	***250***
	Beacon activation	*Beacon*	*Drone*	***200***
	Traverse Neutral Bridge	*Bridge*	*Robot*	***100***

	Dam Crack Inspection Quadrant Identified	*Quadrant Identified*	*Robot / Drone*	***150***
	White Hat Cyber Hacking	*Disconnect / Reconnect cyber cable*	*Robot / Drone*	***300***
	Mineshaft Power Button	*Activate Switch*	*Robot*	***300***
	Sensor Deployment	*Methane Sensor*	*Robot / Drone*	***240***
	Traverse Neutral Bridge mid-point while bridge LEDs are activated	*Beacon / Bridge*	*Robot*	***300***
	Deliver Game Elements (C / Coal with biomining catalyst)	*Game Elements delivered to the coal cart*	*Robot / Drone*	***400***
	Retrieve Game Elements	*Game Elements*	*Robot*	***150***
	Land in assigned colored zone	*Field Landing Zone*	*Drone*	***100***
	Navigate through 1 large loop	*Drone Stunt Zone*	*Drone*	***150***
	Perform Aerial Stunt	*Drone Stunt Zone*	*Drone*	***200***
	Navigate through 1 small loop	*Drone Stunt Zone*	*Drone*	***250***

	Navigate through all three loops	*Drone Stunt Zone*	*Drone*	***700***
	Returning to the starting block area before time expires (limited to 1 full stop per match)	*Field*	*Robot / Drone*	***100***

Table 1 – Autonomous Period Scoring

Teleop Period

Upon completion of the 60-second autonomous period, the remaining 4-minutes are considered a teleop (human control) period. Autonomous functions are not restricted during the teleop period; however, human operators must maintain hands-on control of the robot or drone during the 4-minute period. If autonomous functionality is used within the 4-minute teleop period, doubled points are not awarded.

TeleOp – 04:00 minutes	***Action***	***Element***	***Robot/Drone/ Lab***	***Points Each***
	Movement beyond the starting block area	*Field*	*Robot*	***25***
	Movement beyond the starting block area	*Field*	*Drone*	***25***
	Image Recognition	*Field*	*Robot / Drone*	***100***
	STEM question	*#2, #3, #4, and #5 STEM Question*	*Human*	***250***
	Beacon activation	*Beacon*	*Drone*	***50***
	Traverse Neutral Bridge	*Bridge*	*Robot*	***25***
	Dam Crack Inspection Quadrant Identified	*Quadrant Identified*	*Robot / Drone*	***75***

	White Hat Cyber Hacking	*Disconnect / Reconnect cyber cable*	*Robot / Drone*	***150***
	Mineshaft Power Button	*Activate Switch*	*Robot*	***150***
	Sensor Deployment	*Methane Sensor*	*Robot/Drone*	***60***
	Traverse Neutral Bridge mid-point while bridge LEDs are activated	*Beacon / Bridge*	*Robot*	***75***
	Deliver Game Elements (C / Coal with biomining catalyst)	*Game Elements delivered to the coal cart*	*Robot / Drone*	***100***
	Retrieve Game Elements	*Game Elements*	*Robot*	***50***
	Land in assigned colored zone	*Field Landing Zone*	*Drone*	***25***
	Navigate through 1 large loop	*Drone Stunt Zone*	*Drone*	***25***
	Perform Aerial Stunt	*Drone Stunt Zone*	*Drone*	***50***
	Navigate through 1 small loop	*Drone Stunt Zone*	*Drone*	***125***
	Navigate through all three loops	*Drone Stunt Zone*	*Drone*	***350***

	Returning to the starting block area	*Field*	*Robot / Drone*	***25***

Table 2 – Teleop Period Scoring

League Guidelines

League Overview

The Robot Drone League Jr. season runs from early September through January. RDL Jr. is a multi-week game where scoring elements and game themes change each year, and point values are adjusted to meet the requirements of the game. Teams should benefit from the guidance of teachers or mentors, with the constraint that only the students are the ones allowed to build, program, and operate the robot and drone.

Divisions

RDL Jr. consists of one division: Grades 1st – 5th

Team Organization

Teams may consist of an unlimited number of members; however, RDL Jr. recommends six to ten members per team. There is a limit of 4 players allowed in the driver's station during match play. Team members are allowed to substitute in as needed during a match, as long as there is never more than 4 team members at the drive station at one time.

Team Showcase Video (**New for RDL Jr. 2024!)**

Teams are **required** to submit a five (5) to seven (7) minute video.

In this video, teams will be expected to showcase their robot, drone, and supplemental devices (such as grippers, hooks, etc.). Apart from material aspects, teams will also be expected to discuss different things such as team funding, fundraising, community

outreach, team & project management, and anything else teams feel necessary to describe the scope of accomplishments of the team for the competition season.

As an option, teams are allowed to include technical documents (less than 10 pages), reports, posters, and published materials to aid the RDL Jr. Team Showcase in support of the team's presentation to the judging panel.

New for 2024! Teams are encouraged to take a more in-depth research approach towards the RDL Jr. theme as this challenge relates directly to their communities, states, etc. i.e. the mining industry, and address these issues and potential remedies / solutions in the team showcase video production. Please share if your team incorporated any AI (Artificial Intelligence) into the robot or drone design and programming, gaming strategy, etc.

For Rubric See Page 25

Engineering Notebook

An engineer's notebook is a book in which an engineer will formally document, in chronological order, all of his/her work that is associated with a specific design project. For RDL Jr., the engineering notebook serves a unique purpose in recording the teams' actions and discoveries throughout the RDL Jr. season. Although the engineering notebook is not required to officially compete or to participate in the RDL Jr. Team Showcase presentation (which is required), teams should know that the engineering notebook is strongly recommended.

The engineering notebook should have your team number and school name on the front cover. Engineering notebooks may contain other pertinent information such as community outreach, budgets, sponsorships, mentor notes, goals, and lessons learned. Each team session should be recorded with accurate dates and times of meetings. Team members contributing engineering notebook entries must initial all entries responsible for inclusion.

Illustrations and CAD diagrams are highly suggested. Only one notebook per team shall be submitted. Teams will leave notebooks with the judges' panel and must retrieve them prior to the end of the competition day.

Driver Station

The primary concern during any event is safety. To ensure the safety of all participants and observers, safety restrictions within the driver station must be followed at all times.

The number of team members allowed in the driver station during a match is limited to four (4). Mentors are never allowed at the driver's stations during match play and are not permitted to "coach" from behind the crowd barrier. All players in the driver's station must be wearing closed-toe shoes, as well as safety glasses. Long hair must be pulled back and secured. No loose clothing or dangling jewelry is permitted.

Safety Check

The game has numerous scoring strategies which impact the design and construction of the team robots and the programming of the drones. Following the Four Laws of Robotics, safety is the primary concern for humans, robots, and drones related to inspection. Each robot and drone are required to successfully pass a safety check before competing in the tournament. To pass a safety check, robots and drones need to successfully meet the specifications defined below. If a robot or drone is not deemed safe, it will not be allowed to compete. After a robot and drone have passed safety checks, teams will be given a safety card that is required to bring with them to the assigned drivers station and present to the RDL Jr. official when competing in scoring matches.

SAFETY GLASSES ARE REQUIRED DURING DRONE AND ROBOT OPERATIONS.

Please note that when practicing for or competing in an event, safety should always be the priority. Unsafe operations of both robots and drones can result in serious injuries in the occurrence of misuse or malfunctions.

Robot Specifications

Approved robots for use in RDL Jr. are the Sphero RVR or RVR+, VEX IQ, or similar machines. If your team is considering an alternate robot, please request a pre-competition machine specification review to ensure the platform is competition legal. Teams may use a smart tablet or laptop computer for controlling functions.

Drone Specifications

Approved drones for use in RDL Jr. are the Tello, Tello, Talent, CoDrone EDU or similar machines. If your team is considering an alternate drone, please request a pre-competition machine specification review to ensure the device is competition legal. Teams may use a smart tablet or laptop computer for controlling functions.

Team Match Participation

Team Members

During a match, a team cannot use other participants outside of the driver station to guide robots or drones. If the team is viewed as using external participants to gain an advantage, a red card can be issued. Team members are not allowed on the field during a match and must remain in the driver station or pit at all times.

Under no circumstances shall a team member reach into the field. If the robot or drone is not working, the RDL Jr. official will place the robot or drone in the START / FINISH AREA for the remainder of the match.

Match Setup / Teardown

Before each match, teams have 2 minutes to set up the robot and drone. Teams will also have a 2-minute breakdown period after each match.

Field Reset

After each match, RDL officials will reset the field. This reset period lasts approximately five minutes. During this time, teams are required to remove their robots and drones from the field.

Penalties

Definitions

Yellow cards serve as warnings to teams. Red cards result in a minimum of fifty (50) points to a maximum of five hundred (500) point deduction from a team's score. A driver or pilot issued a red card is required to sit out the following match.

1. Following the intent of the Four Laws of Robotics, a robot may not purposely harm another robot, unless that somehow violates the First Law related to the safety of a human. The field is large, and it is expected that robots from each team will come in close proximity to each other. Robots should not intentionally contact another robot to play defense or prevent the other robot from accomplishing a task.

2. Purposely blocking a robot with another robot to prevent scoring or movement of the robot results in a yellow or red card, depending on any extenuating circumstances.

3. Purposely jamming electronics either during match play or while in the pit or practice area will result in a red card and possible ban from future RDL and RDL Jr. events.

4. Drones that intentionally crash into a robot as a way to prevent scoring will result in a red card for the offending drone pilot. Drones that crash into an opposing robot are not eligible to be rescued during the match.

5. If a drone collision occurs, pilots are awarded a yellow card. If, in the opinion of a referee, a drone was intentionally crashed into another drone or did not show clear intent to avoid a collision, a red card may be issued for the offending drone's pilot.

Yellow Card

A yellow card serves as a warning for robot or drone behavior that is not in the spirit of the Robot Drone League. Any yellow card that is issued can be reviewed by league officials at the end of the match to determine if the actions of the robot or drone under the control of the driver were intentional to gain an advantage and disregard rules. If the league officials determine that the rule violation was intentional, it can be elevated to a red card.

Red Card

A red card issued for poor robot or drone behavior will result in the designated driver's absence in the next match, as well as a point deduction varying from fifty (50) to a maximum of five hundred (500) points from the offending team's final score. The driver / pilot is not allowed in the driver's station during the next match. Teams may receive multiple red cards during a match and the final point deduction is solely at the discretion of the lead RDL Jr. official.

Excessive Mentorship

During an RDL Jr. event, and in the event the work is of a non-emergency or non-0safety nature, mentors, parents, or any adults seen working, or hands on a team's robot by any RDL Jr. Officials, a verbal warning will be issued.

Repeated violations, may result in the team's disqualification from competition matches and the withdrawal from any awards.

Additionally, if judges/officials have suspicion of excessive mentorship which has affected the outcome of the design of the robot, the judges/officials have the right to conduct an investigation into a more thorough understanding of the team's knowledge of their own robot.

Awards

Champions Award – Awarded to the top team that encompasses the overall best in competition, both on and off the challenge field. The following factors are taken into consideration for this prestigious award:

- Challenge field scores
- Team Showcase presentation
- Community Outreach
- Tournament Professionalism
- Collaborative Spirit

Top Score Award – Awarded to the 1st place team based solely on scores finalized at the end of the challenge field play.

Professor's Award – (Championship event only) Awarded to the team demonstrating the best of community outreach that helps to promote STEM learning in their community. Submission for this award is optional and must include a team essay not to exceed 500 words. Pictures, articles, and letters of appreciation or acknowledgment are recommended for serious consideration of the award. Submissions will be submitted no later than midnight on December 1st, 2024.

Engineering Award – Awarded to the team that best demonstrates innovation in design and provides best evidence of documented engineering practices to a panel of SME professionals. An engineering notebook is required for award consideration.

Judges Award* – Awarded to the team that best demonstrates team grit and tenacity no matter the scoreboard. *Note* (This award is optional and awarded at the discretion of the Head Judge).*

Top Dog Award – Awarded to the team demonstrating the highest competition autonomous scores.

Top Rookie Award – Awarded to the best of the best Rookie team competing in their first RDL Jr. season.

Scoring rubrics can be found online at www.robotdroneleague.com

Team Showcase Video Scoring Rubric

Content	Above Expectations (5 pts)	Meets Expectations (4 pts)	Progressing (2 – 3 pts)	Needs Improvement (0 – 1 pt)	Score
Engineering	Both robot and drone designs meet the challenges of the RDL Jr. field with thoughtful consideration for how the robot / drone interact with the field elements to achieve consistent scoring	The robot and / or drone designs meets the challenges of the RDL Jr. field with adequate solutions for how the robot / drone achieve success scoring elements	The robot and / or drone designs have mixed results when attempting retrieval of scoring elements	The robot and / or drone designs have minimal success and failed results when attempting retrieval of scoring elements	
Team Showcase Presentation	The team flawlessly articulated the teams mission purpose, robot and drone design rationale,and provided strong evidence of effective problem solving – ALL TEAM MEMBERS CONTRIBUTED	The team articulated the teams mission purpose, robot and drone design rationale, and provided good evidence of effective problem solving – Most of the team members contributed	The team provided partial evidence of mission purpose, robot and drone design rationale. Some of the team members contributed.	The team provided minimal or no evidence of mission purpose, robot and drone design rationale, Two or less team members contributed.	
Community Impact Outreach for STEM Education	Highly relevant to the community, addresses specific needs of the community and offers substantial evidence of efforts, letters of appreciation, news articles, photos, etc. .	Relevant to the community, addresses specific needs of the community and offers adequate evidence of efforts, letters of appreciation, news articles, photos, etc. .	Somewhat relevant to the community, but lacks focus on community STEM needs.	Minimally or non-relevant to the community, lacks focus on community STEM needs .	
Collaborative Spirit	Extreme team collaboration witnessed in the video	Substantial team collaboration witnessed in the video	Tteam collaboration witnessed in the video	No evidence of team collaboration witnessed in the video	
Video Production Quality	Video production efforts greatly exceeded expectations utilizing available resources.	Video production efforts exceeded expectations utilizing available resources.	Video production efforts met expectations utilizing available resources.	Video production did not meet expectations utilizing available resources.	

Sample STEM Questions

1) Professor Photon planted 3 trees in 9 minutes. How long did it take to plant each tree?

    a. 6
    b. 3
    c. 4
    d. 27

2) Which unit would you most likely use to measure the thickness of a sim card?

    a. millimeters
    b. meters
    c. centimeters
    d. kilometers

3) Which unit would you most likely use to measure the distance from the Earth to the Sun?

    a. millimeters
    b. centimeters
    c. meters
    d. kilometers

4) How long does it take the Earth to orbit the Sun?

    a. 1 day
    b. 1 month
    c. 1 year
    d. 24 hours

5) A magazine reports that a robot sent to Mars drilled on the surface to collect rock samples. What kind of technological instrument is the robot?

a. satellite
b. space observatory
c. space probe
d. spectroscope

6) What would be the best example of a body of water that contains saltwater?

a. Pacific Ocean
b. Tadpole Pond
c. Jordan Lake
d. Neuss River

7) How is a shadow created?

a. Objects blocking the path of light
b. Reflections
c. Darkness
d. Refractions

8) What happens according to Newton's 3rd Law if you let an untied balloon go?

a. The balloon will keep moving but the air will stop.
b. If you hit the balloon with your hand, the force will push your hand back.
c. Air will rush out of the balloon forcing the balloon to move through the air in the opposite direction, but equal in force.
d. Air will slowly seep out of the balloon forcing the balloon to move slowly through the air in the same direction, with ½ half of the force.