



2025 ASABE Student Robotics Challenge

Egg Collection and Sorting

Preliminary Draft - 2024.07.01

Students and Advisors: The 2025 rules are currently under development so your input and feedback is welcome. Please use the comments feature to ask questions or leave comments.

Thanks!

The ASABE P-127 Robotics Competition Organizing Committee

Background and Purpose

The ASABE Student Robotics Challenge provides undergraduate and graduate students a challenging and fun hands-on learning experience. The 2025 challenge will be held during the ASABE International Meeting in Toronto, Ontario, CANADA, July 13th - 16th, 2025.

Competition Summary:

Student teams will build autonomous robots that will race to collect and sort as many chicken eggs as possible within 5-minute trials. Points will be earned for each egg correctly collected and sorted. There will be three different sizes of eggs (small, medium, and large). There will also be “bad” eggs. In addition to the physical competition, teams will also submit a written design report which will be scored. Robot performance and the quality of the written design report will be combined to determine the winners of each division. The competition consists of two divisions: Standard and Advanced. The primary differences are that the Standard Division will have eggs at pre-defined locations and the arena floor will be painted plywood. In the Advanced Division, eggs will be located at random locations within a predefined grid and the floor will be covered with a thin layer of straw. The arena diagrams are shown below in Figure 1.

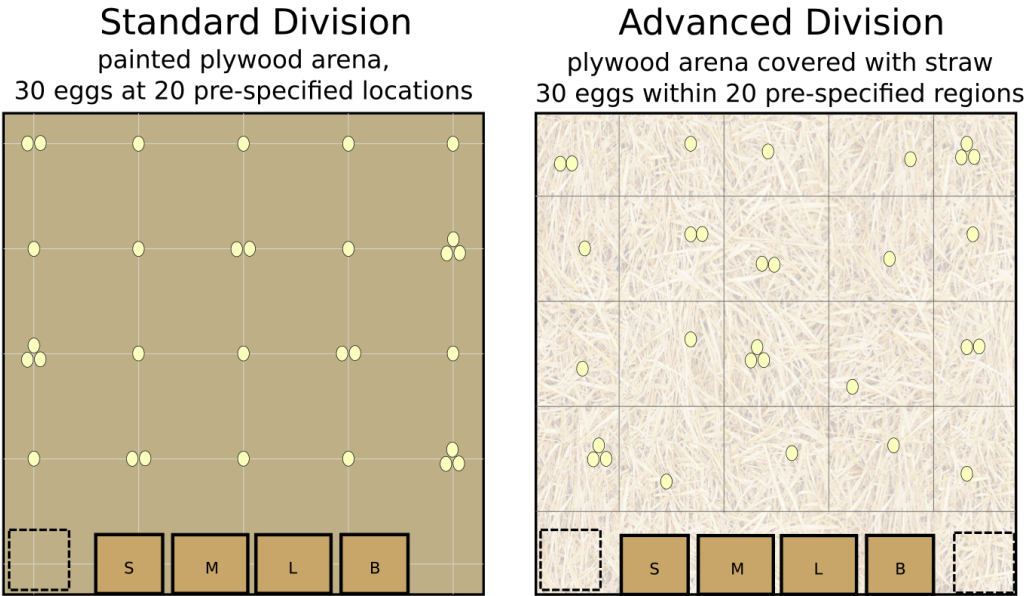


Figure 1: Arena layouts. Each arena is an 8 foot x 8 foot square. Robots start from the dashed line regions, collect eggs and sort them into small (S), medium (M), large (L), and bad (B) bins.

Egg Specifications

Eggs will be constructed of solid wood and can be bought from Amazon.com at [this link](#). A photograph, diagram, and table of egg sizes and weights are provided below.

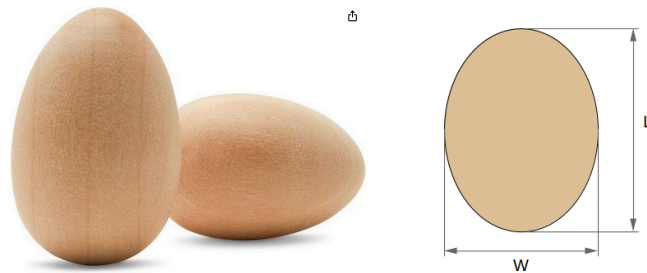


Table 1: Egg Sizes and Masses

	Small	Medium	Large
Width, W	0.875 inches (2.22 cm)	1.125 inches (2.86 cm)	1.75 inches (4.45 cm)
Length, L	1.125 inches (2.86 cm)	1.125 inches (4.13 cm)	2.5 inches (6.35 cm)
Mass	TBD	TBD	TBD

Good eggs will be painted a white/off-white color. Bad eggs will be hollow plastic eggs painted a light tan color. Paint colors will be provided in early August, 2024.

Scoring Overview

The competition consists of two primary components, the robot Performance Score and a written Design Report Score. These components are combined to obtain an Overall Score, which will be calculated as:

$$\text{Overall Score} = (\text{Performance Score}) \bullet (\text{Design Report Score})$$

Performance Scores will be determined through multiple competition trials, and multiple reviewers will judge the Design Report Scores. Awards will be given for the top scores in Performance, Design Report, and Overall Competition.

Divisions

There are two divisions: a Beginner Division (undergraduate students only), and an Advanced Division (undergraduate and/or graduate students). Performance scoring differs between divisions, but the criteria for Design Reports are identical for the two divisions.

1. Teams must declare their division (beginner or advanced) at the time of registration (by June 1, 2025). Teams may elect to change their division until July 1, 2025, after which no division changes will be allowed.
2. A robot may not be used in both the “beginner” and “advanced” divisions.
3. An undergraduate student may be a member of both a “beginner” and an “advanced” team.

Rules Common to Both Divisions

The following rules apply to both divisions:

1. The arena will be a square plywood surface (93 inches x 93 inches) with side walls that are 3.5 inches tall. The interior surfaces of the arena will be painted with matte latex paint. The color will be [Sherwin Williams “Fallen Leaves”](#), in a flat finish (no gloss).
2. Maximum robot size of 12”x12”x12” at the beginning of each trial. Robots may expand in size after activation.
3. Robots earn points by collecting eggs and delivering them to the appropriate bins. Two points are awarded for each egg delivered to the correct bin. Eggs that are delivered to the wrong bin may earn 1 point if the error is “minor” (e.g., a medium egg delivered to a small or large bin). However, the team will lose 2 points for each major error. The scoring table summarizes the possible point values below.

Table 1: Points awarded for all possible sorting outcomes.

	Small Bin	Medium Bin	Large Bin	Bad Bin
Small Egg	+3	+2	0	-1
Medium Egg	+2	+3	+2	-1
Large Egg	0	+2	+3	-1
Bad Egg	-1	-1	-1	+3

4. Eggs that are dropped by a robot will immediately be removed from play by the judges. Eggs may be rolled.
5. Timed trials: Each trial will be 5 minutes long.
6. Only 1 robot allowed per team.

Beginner Division Rules

The Beginner Division is designed for undergraduate students with limited robotics coursework and those new to the competition.

1. Undergraduate students only.
2. Maximum of two teams per institution, and limit of one robot per team.
3. The arena will consist of a painted plywood surface (see below for details)

Advanced Division Rules

The Advance Division is designed for upper-level undergraduate and graduate students and those who are familiar with the competition.

1. Both graduate and undergraduate students may participate on a team.
2. Maximum of one team and one robot per institution.
3. The arena will consist of a painted plywood surface which will then be covered with a thin layer of straw (see below for details).

Team and Participant Registration

Each *team* must complete the competition [registration form](#) by June 1, 2025; this team registration for the competition is free.

For access to the venue, each *participant* must [register for the ASABE Annual International Meeting](#). A special rate of \$800 (total) is available for groups of exactly four participants until May 1, 2025 by submitting the [2025 ASABE Student Competition Reduced Rate form](#) to awards@asabe.org; contact Corey Sayles <sayles@asabe.org> for more information. ASABE also offers “Early Bird” registration rate to participants who register before XXXXXX, 2025.

Written Design Report (Due July 1, 2025)

A written design report will be submitted to provide documentation of the robot design and functionality. Design reports will be judged according to the criteria below. An award will be presented for the best design report. Design reports are to be submitted in PDF format using [this google form](#) by July 1, 2025. Design reports and scores will be publicly available after the competition.

I. Technical Merit	Points Possible
A. Establishment of Need and Benefit to Agriculture	5
B. Approach and Originality	5
C. Definition of Design Objectives and Criteria	10
D. Parts List (with MSRP and sale prices) and Table: <ul style="list-style-type: none">■ Actuators, sensors, microprocessors, screen(s), etc.	5
E. Hardware Description <ul style="list-style-type: none">■ Engineering drawings, CAD models, pictures, etc.■ A clearly written description of how hardware works	20
F. Software Overview or Logic Flowchart: <ul style="list-style-type: none">■ Driving, sensing logic, etc.	20
G. Appropriateness of Tests and/or Performance Data	5
H. Achievement of Objectives	5
II. Design Report Quality & Composition	
A. Professional-looking page design and layout	5
B. Appropriate organization and logical flow of information	5
C. Completeness	5
D. Clarity and style	5
E. Quality of the documentation - including figures & drawings	5
Total:	100

Rankings and Prize Structure

As funding allows, monetary prizes will be awarded to the teams with the top three overall scores in each division.

The first place robot performance and first place report in each division will also be acknowledged, but no monetary prizes will accompany these distinctions.

Performance Scores

1. Each team's Performance Score will be determined by averaging all trials in the finals round except for the team's lowest-scoring trial.

Design Report Scores

1. Written design reports will be scored by at least two different judges.
2. Judges will recuse themselves from scoring reports when a conflict of interest exists.
3. Judges' scores will be normalized before being combined to account for variation among judges.

Equal Scores (Ties)

Where there is a tie, teams will split the prize for the tied awards. For example, a tie for second place will result in the two teams splitting equally the awards for 2nd and 3rd place. In this case, two second-place awards will be given, and no 3rd place awards will be given.

Schedule

The following schedule is planned but is subject to revision by ASABE as needed.

Sunday, July 13 - practice rounds (morning), qualifying rounds (afternoon)

Monday, July 14 - finals (afternoon)

Tuesday, July 15 - no robotics competition events - enjoy the conference!

Wednesday, July 16 - award ceremony

Qualifying and Finals Rounds

Purpose: To encourage a high level of robot performance and to ensure that the finals round is exciting and entertaining for spectators and other teams, robots must perform sufficiently well in qualifying rounds to qualify for the fast-paced finals rounds.

Procedures: Both qualifying and final rounds will operate upon the same set of rules and procedures. Up to five qualifying rounds will be held, and each team will complete one trial per round. The exact number of qualifying rounds will depend upon the number of teams that participate in the competition.

Qualifying Rounds Ranking Scheme: Once all qualifying rounds are completed, each team's scores will be compiled. The lowest score from each team will be dropped and the teams' trimmed average score will be calculated. The trimmed average will be used to rank teams and determine which teams will be included in the finals rounds.

Qualifying for Finals Rounds: Participation in the final round will be determined according to the qualifying rankings. The judges will review the distribution of scores for each division and determine the rank cut-off for participating in the finals. It is anticipated that the cut-off will

differ between divisions. All teams above their division's cut-off will be invited to participate in the finals. The exact value of the cut-off rank will depend both upon overall performance and upon the number of teams that participate in the competition. The judges will endeavor to include as many teams as possible, given time constraints for running the finals rounds and considering overall performance. As general guidelines, robots that only navigate the course will likely not be invited to participate in the finals, and robots that successfully perform a significant amount of trimming will almost certainly be invited to the finals.

Final Rounds: Final rounds will be run in the same manner as qualifying rounds. Similarly, the number of rounds will be determined based on the number of teams and the time available, and the final performance score will be the trimmed average of each teams' trial scores.

Competition Format

1. The order in which teams will complete their trial will be announced at least 15 minutes before the start of each round.
2. Teams are responsible for monitoring the progress of the competition and reporting to the playing field with their robot before their trial begins.
3. To keep the competition on schedule, each trial will begin no more than five minutes after the previous trial ends.
4. Preparation Time: Each team will have up to 1 minute to prepare their robot on the playing field. If a team is ready before 1 minute has elapsed, they may inform the judge and activate their robot upon the signal from the judge. However, after 1 minute has elapsed, the round will automatically begin.
5. Competition Time: Once the round begins, each robot will have up to 5 minutes to score as many points as possible.
6. Finishing a Trial: A robot can finish the trial early by returning to corner "A" or "B" before the 5-minute timer sounds AND notifying the judge that the team wishes to conclude the trial. If the 5-minute timer sounds before the robot returns to a corner, a judge will gently pick up the robot.
7. Interventions: If a robot is touched after it begins the trial, it must be returned to the starting position. There is no penalty for touching a robot, but the timer will continue to run as the robot is returned to the starting position. *Note: this provides a simpler replacement for previous rules surrounding "Autonomy Score" and "Intervention Penalty". The intent is still for robots to be fully autonomous, but we recognize that occasionally robots may get stuck or need to be rebooted. This is not intended to introduce loopholes or strategic options. Judges have the authority to warn and ultimately disqualify teams suspected of exploiting this intervention policy to increase*

their score.

8. Due to space and resource limitations at the competition, each team must designate up to three (3) team members who are allowed in the competition area for each trial. Additional team members will be permitted in the setup/work area as space permits.

Playing Field and Egg Specifications

The playing field will be constructed using two 4' x 8' sheets of plywood. Arena edges will be constructed using 2x4 boards (1.5" x 3.5"). Further details on the playing field construction will be provided at a later date.

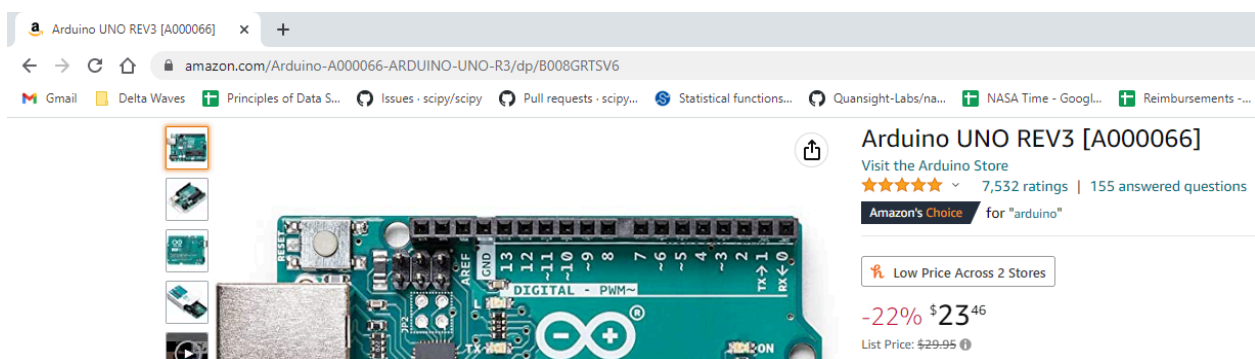
Additional Regulations

Controller Restrictions

Robots must be fully autonomous. All control components must be onboard; wireless communication is not allowed. With the exception of activation, deactivation, and reasonable intervention allowed by the interventions policy above, robots controlled by humans during a trial will be disqualified.

To make the competition more accessible to teams with limited budgets, the total cost of control components (e.g. CPUs, GPUs) used on a robot is limited. Specifically, the sum of the manufacturer's suggested retail price (MSRP, also known as list price) of control components must not exceed \$500. This restriction does not include the cost of sensors with basic integrated processing. If you are unsure whether a component will be included in this budget limit, please reach out to the competition committee (P-127@asabe.org).

Please document the MSRP at the time you purchase your hardware (e.g. by saving webpages or taking screenshots). For instance, here is documentation of the \$29.95 list price / MSRP of an Arduino UNO Rev 3 on 11/22/2022, which is distinct from the \$23.46 sale price.



Here we listed out a few of the popular computers/controllers and their MSRP for reference:

Model	MSRP	Model	MSRP
Arduino UNO R4 WiFi	\$27 (source)	Arduino UNO R4 Minima	\$20 (source)
Raspberry Pi 4 2GB	\$35 (source)	Nvidia Jetson Nano 2GB	\$59 (source)
Raspberry Pi 4 4GB	\$55 (source)	Nvidia Jetson Nano 4GB	\$99 (source)
Raspberry Pi 4 8GB	\$75 (source)		

If you have questions about these restrictions, please consult with the competition committee.