URC 2018: Regular Division Rulebook

Competition Overview

Title: Robotic Sowing

Competitors will have to build robots that can autonomously sow seeds in designated locations. In recent years, automation driven by IoT (Internet of Things) continues to be adopted across diverse fields, with agriculture being no exception. Agricultural automation not only makes effortless mass production of food a very real possibility, but also a viable solution to food shortages caused by a projected world population increase of one billion in the next decade. The mission of these robots is to set off at the Starting Zone and sow seeds in Sowing Areas on the Field.
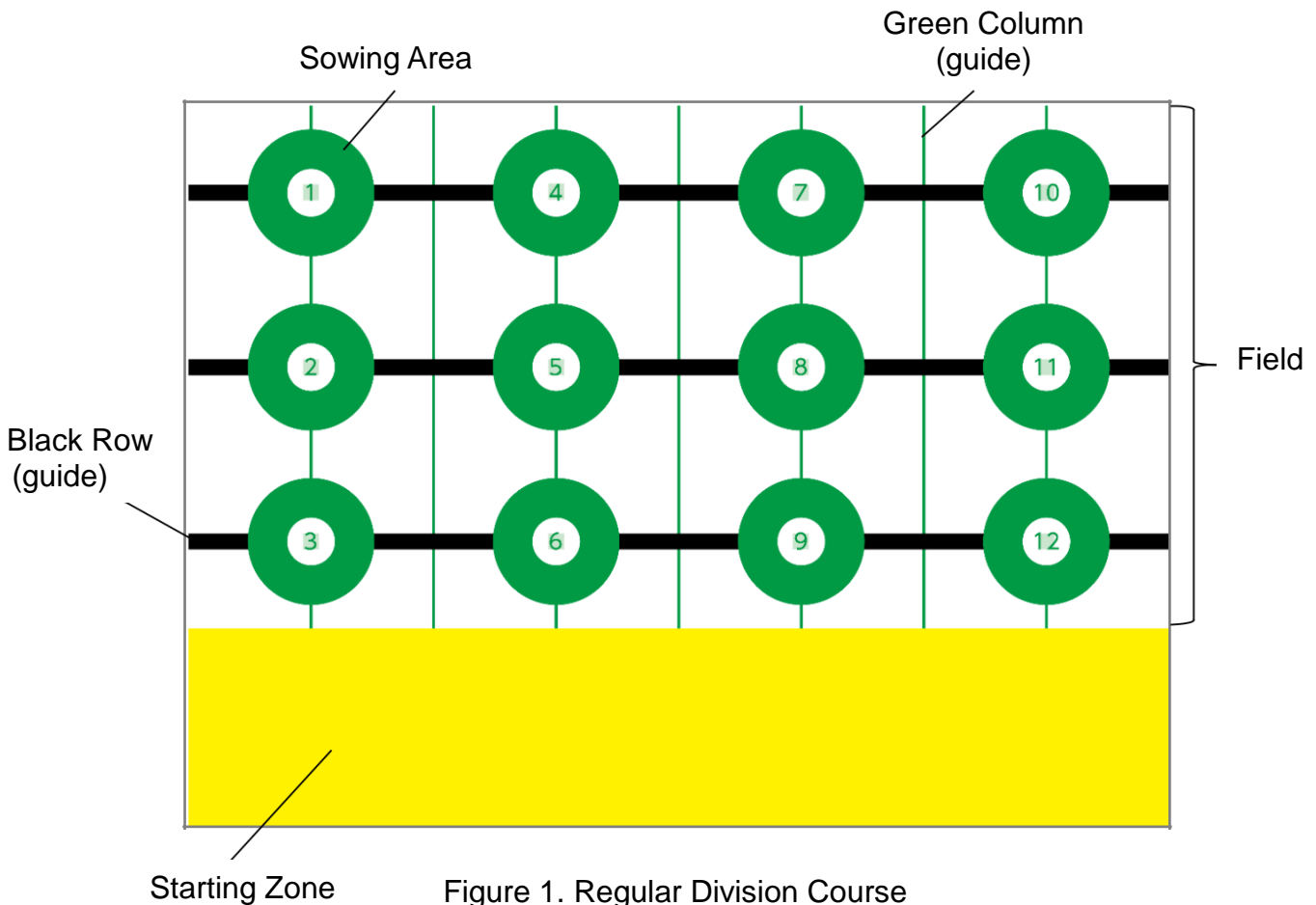

Figure 1. Regular Division Course

1. Competition Overview

o **Missions**

◇ Basic Mission

Carry seeds from the Starting Zone and sow them in the Sowing Areas. This will continue until all seeds have been sown, and the mission is complete once the competitors raise their flags and declare, "Stop!"

◇ Special Mission

The special mission will be held during finals. The content of this mission will be announced the day of the competition.

◇ Robot Requirements

> Sow seeds as precisely as possible in the Sowing Areas.

> Complete the mission in the shortest possible time.

o **Course Guide**

◇ Starting Zone

The Starting Zone is the yellow area in front of the course. Competitors are allowed to handle any part of the robot still within the Starting Zone.
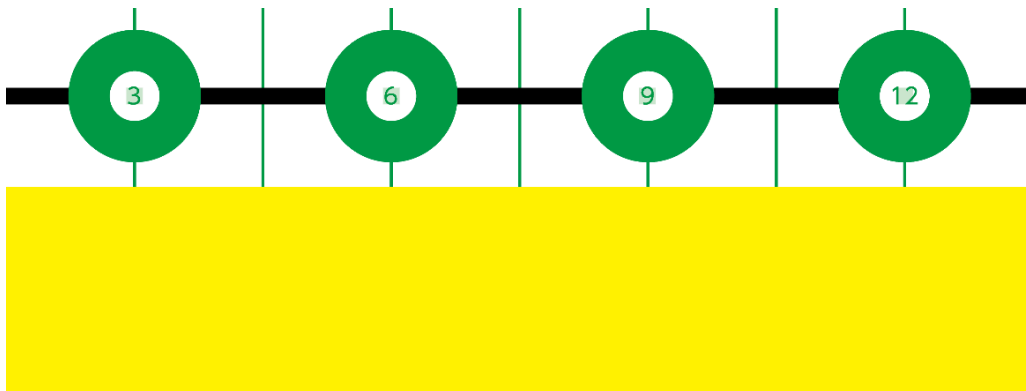

Figure 2. The Starting Zone

Seeds will be built from Artec Blocks as shown in Figure 3. All seeds on the course have the same shape.
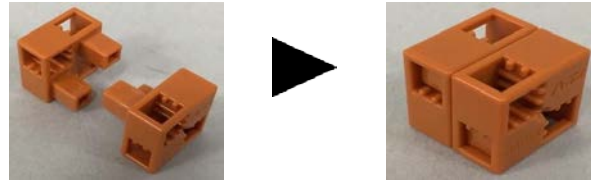

Figure 3. Assembling a Seed

The Field

Robots will sow seeds on the field in front of the Starting Zone
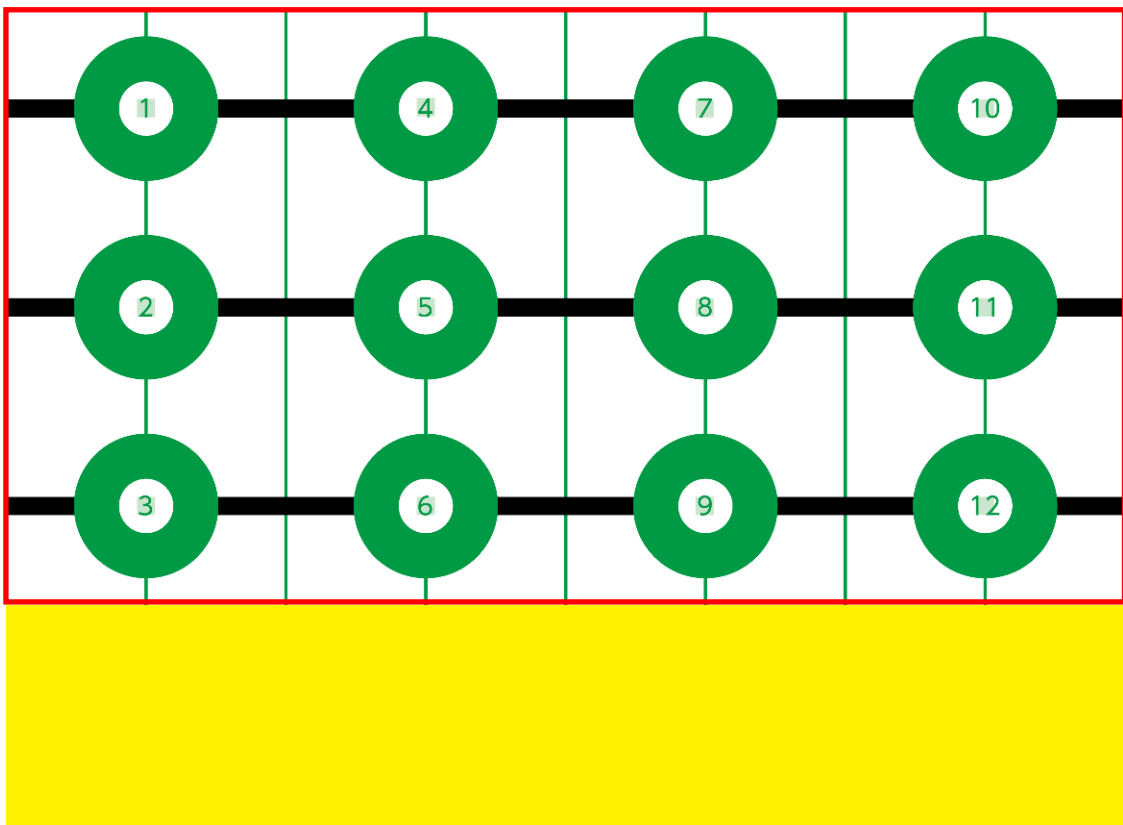

Figure 4. The Field

◇ Sowing Areas

Sowing Areas can be found in the green circles on the Field. The Sowing Areas are numbered one to 12 and placed at the points the green columns and black rows on the Field intersect.
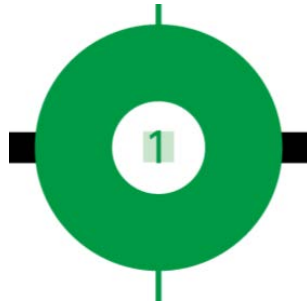

Figure 5. A Sowing Area

2. Competition Rules

1) Each round of the competition is 180 seconds (3 minutes).
2) Six seeds and a flag are given to the competitors by a referee before the start of the round.
3) Robots are placed on the Starting Zone and start at the sound of the referee's whistle.
4) Robots must not enter the Field before the round starts (this includes the air above the Field).
5) Seeds must not be placed on the robot before the round starts.
6) No retries are allowed in during the round.
7) During the round, competitors are allowed to touch their robot in order to change its position, place seeds on it, or use buttons to control it, provided they only touch parts of the robot that are inside or on the competitors' side of the Starting Zone.
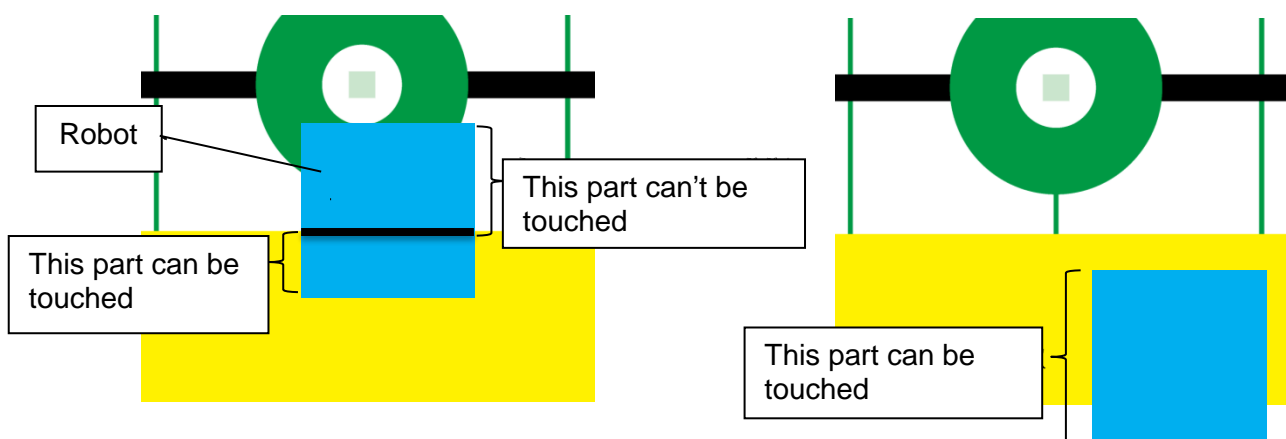

Figure 6. Changing a Robot's Position

8) A competitor touching a robot in any situation other than those designated in 7) will result in a 40 point deduction from their score. In the case of 14), however, competitors are allowed to touch their robot in order to repair it.

9) Six Sowing Areas will be selected from areas 1 to 12 (see page 10, Figure 8 for each number's location). These Sowing Areas will not be revealed until the day of the competition and are decided fairly by a referee's lottery at each venue.

10) Seeds (brown blocks) are considered sown once they're placed on the Field. Any seeds not on the Field once the round has ended (for example, a seed still held by the robot) will not be counted towards the competitor's score.

11) Points will be awarded for each seed sown on the Field. Seeds sown in the inner circle of that day's Sowing Areas are worth 40 points, while seeds sown in the outer circle are worth 20 points. Seeds sown anywhere else on the Field are worth 10 points. The competitor's score is calculated by counting the number of seeds sown by the end of the round, and robots are fully allowed to move the seeds around during the round.

Outer Circle

Inner Circle

40 points

20 points

10 points

No points
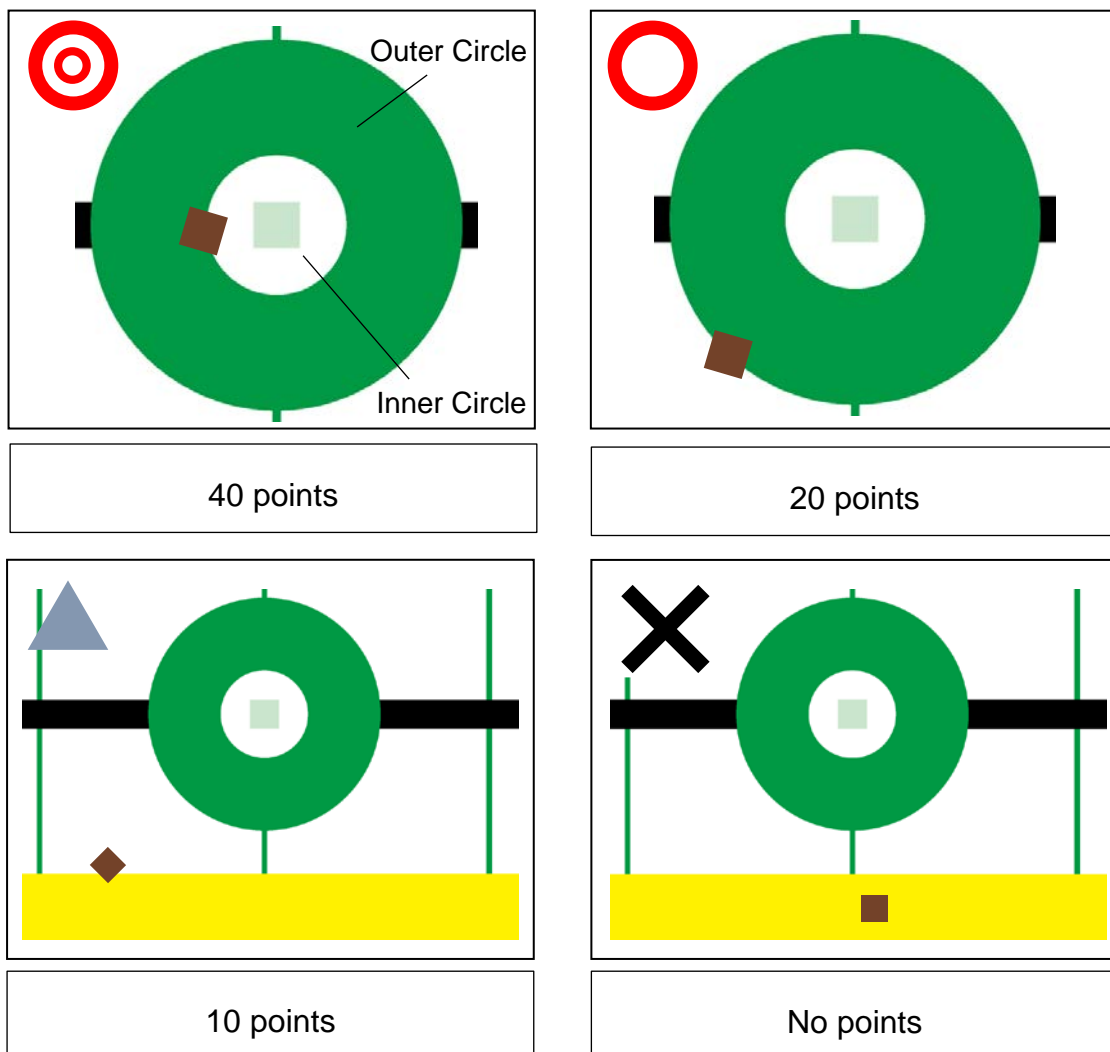
12) In the event multiple seeds are sown in one designated area, only the seed closest to the center will be counted. All other seeds will count as having been sown in the Field outside of the Sowing Area.

13) Any sowing not performed by the robot as a result of its programming is not allowed, and any seeds sown in this manner will be moved back to the Starting Zone by the referee. The competitor will not be allowed to move the robot during this time.
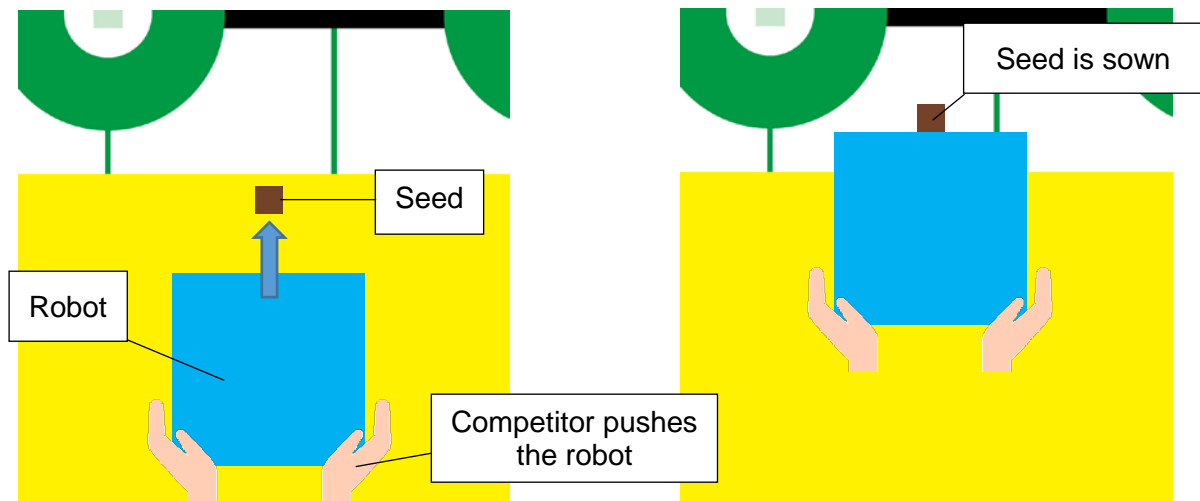

Figure 7. An Illegal Sowing Method

14) In the event the robot can't make it back to the Starting Zone and thus can't continue the round, competitors are allowed to handle the robot in order to bring it back to the Starting Zone. Each time this happens, 40 points will be deducted from the competitor's score. Any seeds moved by mistake while handling a robot will be returned to their original location by the referee. Competitors will not be allowed to move their robots during this time.

15) Any robots that fall apart during the round can be repaired by the competitor in the Repair Zone outside of the course.

16) Bonus points are awarded for completing the special mission. No points are deducted for failing the special mission or not attempting it at all.

17) The following events will end the round:

・ Competitors declare, "Stop!"

・ The round has reached 180 seconds.

・ Competitors violate any rules.

3. Competition Flow

1) Each team gets two rounds. Only the round with the highest score of the two will count towards the team's rank.

2) Teams are given time for a trial run on the actual course before each round. Each team can use this time to adjust their robots and programs. The order of these trial runs is decided by a lottery held by the hosts of the competition.

3) Competitors can also freely adjust their robots and programs on the practice course while other teams are doing their trial runs.

4) Teams will also use their time in 2) and 3) to prepare for the special mission.

5) Robots will be checked by inspectors once all teams have finished their trial runs. All robots which have passed inspection will be placed in a designated location and can't be touched until the round starts. Programs should be transferred prior to inspection, as no changes can be made to any robot after it's been inspected (this includes during the round).

6) The first round will be held in the order decided by the lottery held by the hosts of the competition. After being called, competitors will retrieve their robot and wait in the designated location until the round starts. Robots and programs can't be adjusted during this waiting period.

7) Once the first round ends, competitors will immediately move their robot to the designated location and wait until they're allowed to adjust it. Robots and programs can't be adjusted during this waiting period.

8) There will be an adjustment period between the first and second rounds. Teams will be allowed to use this period to adjust their robots and programs on the practice course.

9) Once the adjustment period is over, robots will be inspected again as they were in 5).

10) The second round will be held in an identical way to the first round in 6). Once the round ends, competitors will immediately move their robot to the designated location and wait until the results are announced.

11) Ranks are calculated using the results of each team's rounds.

12) In the event different teams have the same score, the team with the shorter completion time gets the higher rank.

4. Competition Robots

1) Only one robot is allowed per team.
2) See **Appendix 1** on page 11 and **Appendix 2** on page 12 for the ArtecRobo parts and Artec Blocks competitors can use to build their robots.
3) Each robot can only use one Studuino. There are no restrictions on the number of other parts.
4) Any parts from 2) can't be modified.
5) Competitors are not allowed to reinforce their robots using parts (such as screws, adhesive tape, etc.) other than those listed in 2).
6) Robots must not exceed 45 cm in width, 25 cm in length, and 45 cm in height at the start of the round.
7) There are no weight restrictions on robots.
8) While robots are allowed to transform at the start of the round, but must stay in one piece.
9) Any programs for the robots must be made using one of the following pieces of software.
   ・Studuino Icon Programming Environment
   ・Studuino Block Programming Environment
   ・Arduino IDE
   ・Dolittle
   ・Atmel Studio
10) Robots must use three AA batteries.
11) Competitors may only use parts and PCs that they've brought themselves to adjust their robots and programs during the trial run before the start of the round.
12) Robots and programs can only be built by teams actively participating in the competition. Any competitors who violate the rules of the competition will be banned from competing for three years (starting with this year's competition).

5. Scoring

Scores are calculated based on the location of each seed at the end of the round.

1) Seeds sown within the inner circle of one of that day's Sowing Areas are worth 40 points.

   Seeds within an outer circle, but outside an inner circle are worth 20 points.

   Seeds sown on the Field outside of an outer circle are worth 10 points.

2) A 40 point deduction is taken each time the competitor has to manually bring a robot back from the Field to the Starting Zone.

3) A 60 point bonus is awarded for completing the special mission.

4) The final score is the sum of items one to three.

(Scoring Example)

For Sowing Areas 1, 3, 5, 8 and 12

Inner Circles

The Field
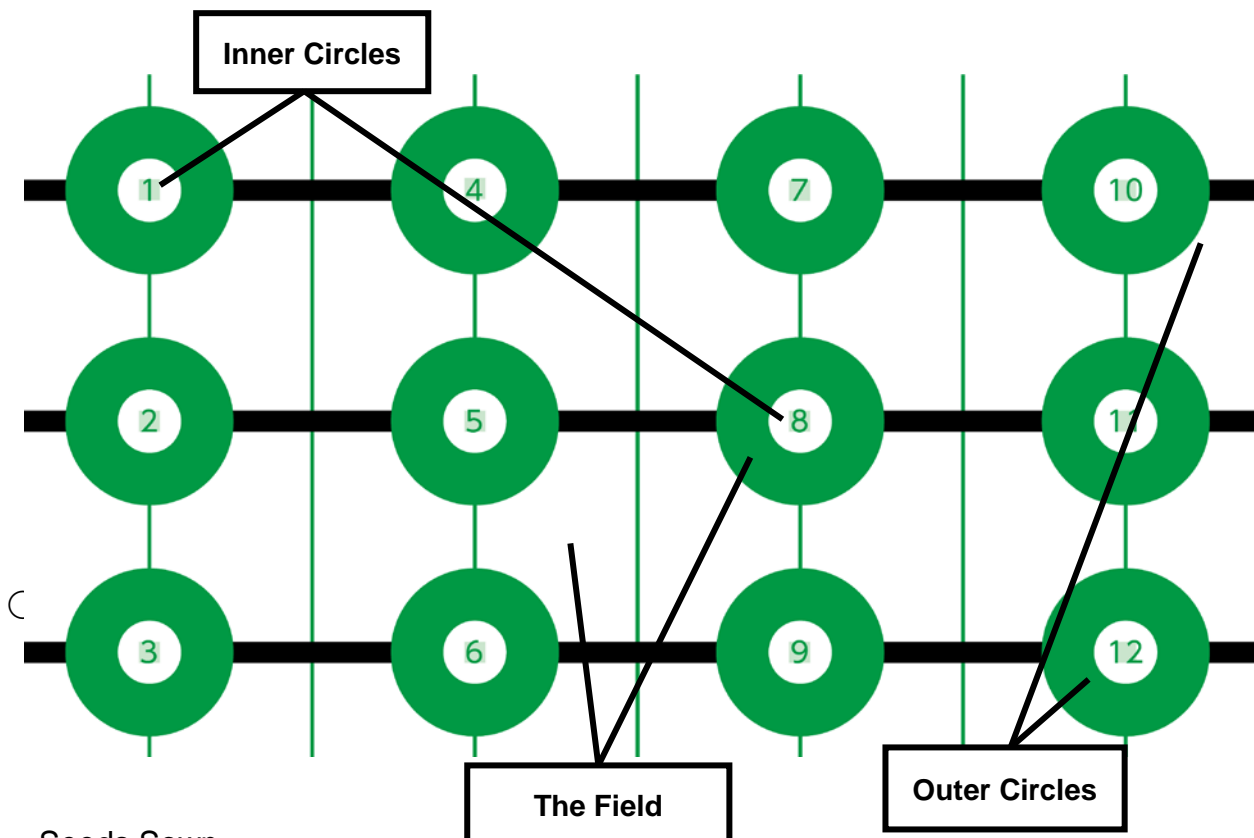
Outer Circles

・ Seeds Sown
- Inner Circle Seeds x 2 → 40 points x 2 = 80 points
- Outer Circle Seeds x 2 → 20 points x 2 = 40 points
- Field Seeds x 2 → 10 points x 2 = 20 points

Final Score:
140 points

6. The Competition Course

A set including the Competition Course and blocks (seeds) will be distributed to each team once their participation has been confirmed.
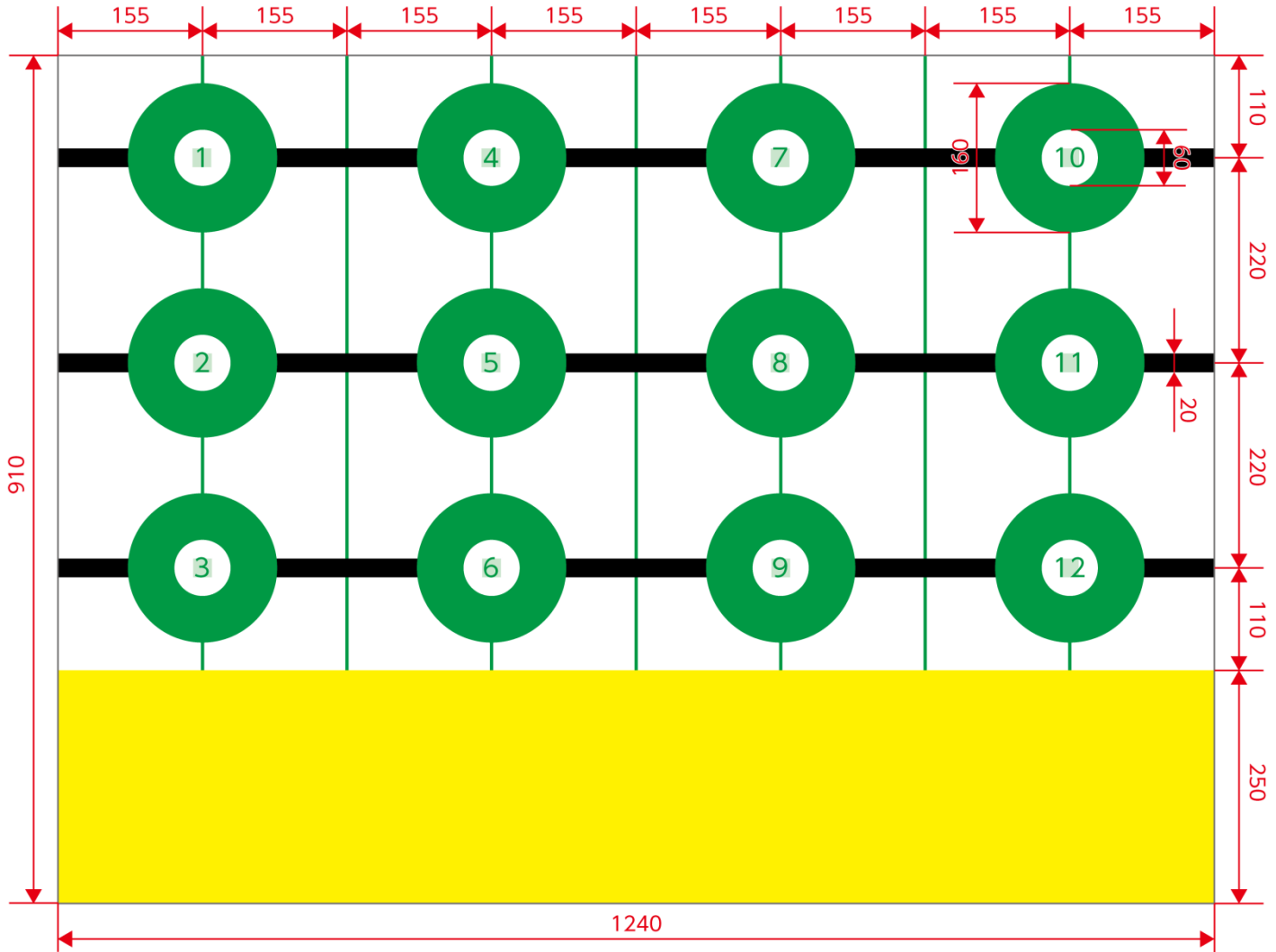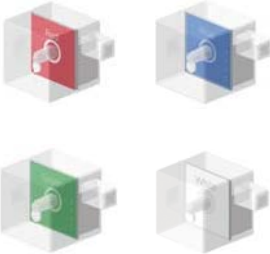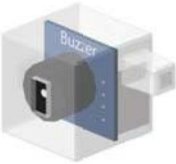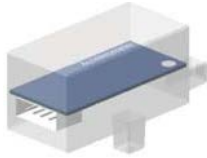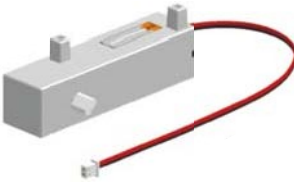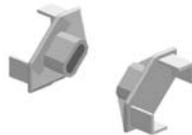
Figure 8. Course Dimensions

Appendix 1. Permitted ArtecRobo Parts

Studuino	Battery Box	LEDs (red, blue, green, white)	Buzzer
Touch Sensor	Light Sensor	Sound Sensor	IR Photoreflector
Accelerometer	Servomotor	DC Motor	DC Motor Connector
Sensor Connecting Cable (S) 3-wire, 15 cm	Sensor Connecting Cable (M) 3-wire, 30 cm	Sensor Connecting Cable (L) 3-wire, 50 cm	Extension Cable for Servomotors

Appendix 2. Artec Blocks

Basic Cube	Triangle	Half A	Half B
Half C	Half D	Axle	Wheel
Beam	Disk	Gear (L)	Gear (S)
Gear Rack	O-ring		
		*Gear tires are not allowed	