



Recycle - Bot

Robotics Challenge

2018-2019

Level:	High School
Type of Contest:	Team
Composition of Teams:	3 to 5 Students per team
Educational Overview:	Recycling has produced great benefits to the environment and has helped reduce the amount waste that is taken to the landfills. Because of this, natural materials can be conserved and what is recycled is then reused and can be made into something new. The arduous course of recycling cannot be solely done by human power, therefore, robots and other machines are needed to assist in the process. Robots are needed to collect recyclable waste and machines then help separate the different recyclable materials such as metal, paper, plastic and glass.
Challenge Objective:	The purpose of this competition requires a team of students to collaboratively design, build, program and test a robot to do various tasks in both autonomous and teleoperation mode and to engineer a sorting device that will separate different sized circular objects. The challenge requires the team to complete three tasks. First task is to locate a bucket randomly placed on the field, second task is to take that bucket to the delivery zone and travel to the trash pit to collect recyclables, and the third task is to take the recyclables collected to the delivery zone so that they can be placed into a sorting device where paper, metal, plastic and glass will be separated.

The purpose of the competition is to encourage gracious professionalism that leaves everyone involved feeling valued with a sense of integrity and teamwork. The goal is not just to win, but also to participate fairly and to extend the gracious professionalism and respect to all teams and students involved.

— For Inspiration and Recognition of Science and Technology (FIRST)

Definitions:

1. Autonomous: Mode in which the robot moves on its own without human input.
2. Teleoperation: Mode in which robot moves through human control (ie. remote control).
3. Starting Zone: Area where the robot must start at the beginning of each round and after each reset.



4. Trash Pit: Communal area at the center of the field open to other teams where recyclables are located.
5. Sorting Area: Area specifically made to have the sorting device placed on the field.
6. Delivery Zone: Area assigned for robots to deliver the bucket and all collected recyclables.
7. Recyclable Sorting Device (RSD): Device used to sort objects such as paper, metal, plastic, and glass which are collected from the center of the field.

Robot & Materials:

1. Teams have the liberty to use any material to construct the robot. Imperial Valley MESA will only provide the kit/ parts listed below and simple recyclable materials.
2. All teams will receive a VEX kit provided by the Imperial Valley MESA Program. Kits will be provided and assigned by your MESA advisor.
 - a. Robotic kits and parts include: VEX EDR Robot P/N: 276-2700 & Sensors P/N:276-2155, 276-2216, 276-2174, 276-2159, and 276-2156.
3. Teams may not do any alteration to any of the VEX Kit Parts provided by the Imperial Valley MESA Program
 - a. Alterations include: adhesives on kit parts, holes or modifications to kit parts, and or bending kit parts.
 - b. NOTE: Robots with alterations will need to be fixed prior to competition. If alterations cannot be undone, then the team will not be allowed to compete.
4. There are no dimensional restrictions as to the building of the robot.
5. Batteries will not be available on the day of the competition.

Recyclable Objects:

Metal: 1/2" Steel-Ball

Plastic: 1-in Foam Color Cubes

Glass: 1" Shooter Marbles

Recyclable Sorting Device (RSD):

1. For this competition, teams will build a Recyclable Sorting Device (RSD) and will separate the recyclable objects collected by the robot from the center of the field that represent metal, plastic, and glass.
2. The RSD can be made of any materials. We encourage teams to use as much recyclable materials when building the RSD.
3. Maximum dimensions are length: 40 inches, width: 20 inches, and no height restriction. There are no minimum dimension restrictions.
4. The device must separate all objects into the three different categories; metal, plastic, and glass into three separate containers.
 - a. The containers will be of the following dimension
 - i. Container: 1 qt. Multi-Mix Container
 - ii. They will be provided by the IV MESA Program.
 - iii. Container must be adapted to the RSD so that they can be easily removed at anytime, things such as velcro/ rubber bands may be used but no adhesives since multiple teams will be using the containers.
 - iv. Adaptation and containers must be made to fit within the RSD's dimension limitations.



5. Once materials are placed onto the RSD to be filtered, the human player cannot engage the recyclable materials. Human player intervention is only allowed if the RSD has any external actions to facilitate the movement of the recyclable materials.
6. 10% will be deducted for every recyclable material sorted incorrectly in the bucket.
 - a. Ex.
 - i. Metal bucket: 10 Metal Steel Ball collected and 2 Glass Marbles
 $10 \times 3 = 30 - 20\% = 24$ points for that bucket
 - ii. Plastic bucket: 8 Plastic Foam Cubes collected and 8 Metal Steel Balls
 $8 \times 5 = 40 - 80\% = 8$ points for that bucket

Game Rules:

It is recommended that teams are to program their robot in *Competition Mode* in order to make the transition of *autonomous* to *teleoperation* mode automatically. Therefore, once finishing your robot's autonomous program, you must record the time it takes for it to complete the autonomous task. Once your team has the time recorded, then change the time setting in your program to best suit your robot.

First Task - Autonomous Mode (Must be completed before being able to move on to the following task.)

1. At the Judge's signal, all teams will start their robot's autonomous program at the designated Starting Zone.
2. The robot will then begin to locate the bucket that is randomly placed on the designated area in the field. (Refer to 8pg for field diagram)
 - a. Points will be awarded for locating the bucket successfully.
 - b. The robot must alert the Judge by making contact and remaining still for at least 3 seconds when encountering the bucket.
 - c. The designated area is about to be 4ft by 6ft.
1. At Judge's signal, teams may proceed to teleoperation mode after successfully locating the bucket.

Second Task - Teleoperation Mode

1. Return bucket to the Delivery Zone. The Human Player has the option to grab the bucket from the robot once its has entered the delivery zone or allow the robot to place it onto the Delivery Zone.
2. At this point, robots may enter the Trash Pit to collect as many recyclable materials as possible.
 - a. Trash Pit area is estimated to be 6ft by 6ft.
3. Once collected, Robot must return to Delivery Area in order to begin sorting.
 - a. The Trash Pit is the only designated area where dragging and pushing is allowed.
 - a. Any recycled material dropped from the Trash Pit to the Delivery Zone will be returned to the Trash Pit.

See Scoring on page 4

Third Task - Human Input

1. Once robots arrive to Delivery Zone, the robot must unload recyclable materials onto the Delivery Zone.
1. Once materials are delivered to the Delivery Zone, the Human player then must place all items inside the bucket that was collected during the First Task, into the sorting device. All items must be dumped into the sorting device at the same time to be properly sorted and scored.
2. Process continues until time is up.

Bonus Task

1. Aside from the three recyclable materials in the Trash Pit, there will also be four orange cones.
 - a. Two of the four cones will incorporate two containers with material that was not properly recycled.



- b. Each container will be consider 10 bonus points when found and deliver to the Delivery Zone successfully.
- c. Dragging, pushing, and pulling are allowed for the bonus task.

Competition Logistic Rules:

1. Team Captain is responsible of checking in their robot during the Competition.
 - a. Robots will be impounded after registration and no alteration will be allowed.
2. Each team will have the opportunity to compete in two non-consecutive matches. Each match will have 5 minutes.
3. Robots will complete each match in both autonomous and teleoperation mode.
 - a. Teams must attempt to complete the first task in autonomous mode in order to proceed to teleoperation mode, as soon as the autonomous portion is complete, robots may continue to Task 2.
 - b. If after ONE minute the task has not been completed autonomously, the team can switch to teleoperation but must still complete the first task (with no points earned for autonomous) before continuing to the second task.
4. Teams must begin at the Starting Zone and the two front wheels must be behind the green starting line during each match. (See field specifications for details.)
5. Teams will be allowed to reset their robot as many times as needed while on autonomous mode, however, time will continue to run.
 - a. Teams that need to reset must notify the Judge. The robot will then be brought back into the starting zone by the Judge and the team will be able to restart their autonomous program.
 - b. Teams will be allowed to reset their robot ONLY during autonomous mode.
6. Robots may NOT block or interfere with the other competing robots unless they are in the trash pit.
 - a. Robots that interfere(purposely) with each other and/or become immobile during autonomous mode will be allowed to reset, however, time will continue to run.
7. Robots that are in teleoperation mode will NOT be allowed to reset unless there is interference by another team's robot that disables a robot ex. turned upside down, cables pulled out. In that case a judge will remove the robot and give it to the team to fix while the time continues to run.
8. During competition, all team members MUST stay in their assigned area at all times.
9. Teams will begin at Judge's signal. Any robot that fails to do so will be considered a false start. A false start will be considered as the following:
 - a. A robot is released or their program starts before the Judge's signal.
 - b. If a false start happens, then all robots will reset and the match will restart.
 - c. Once the vehicle exits the starting zone, the run is considered legitimate.
10. At least two wheels must be on the field at all times.
 - a. Penalty for not adhering to the rule in teleoperation mode will result in automatic return to Starting Zone.
11. Robots must stay within their assigned area at all times and must not enter any other competing robots' area.
 - a. The only interaction that a robot can have with another competing robot is within the Trash Pit.
 - b. Not abiding this rule will lead your team to disqualification.
12. Teams will be allotted time to practice or make changes to the robot's program or to the robot itself after all teams have completed their first match.
13. Teams will be randomly assigned a field and lane which will be provided the day of competition.
 - a. Teams should assign roles to each teammate. (example: lead engineer, human players, teleoperator, etc.)



- b. Only one teleoperator per match.

Scoring:

Overall score will consist of the total for the following components:

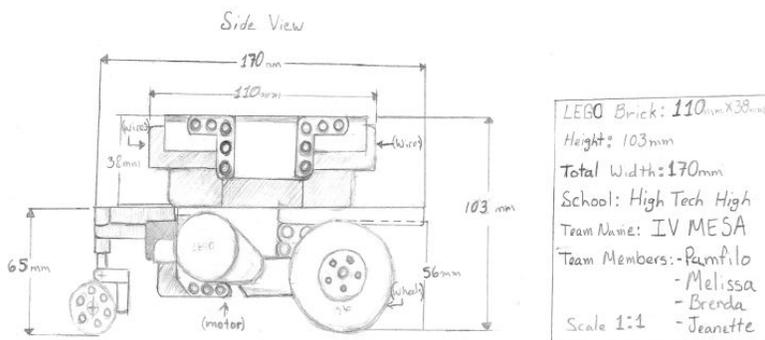
- Scaled Drawing Score
 - Maximum score possible for Scaled Drawings is **10 points**.
- Video Presentation Score
 - Maximum score possible for Video Presentation is **10 points**.
- Total Score for Match 1 and 2
 - During each match, teams will be able to score the following points:
 - Autonomous Mode: **12 points** for successfully completing task under ONE minute.
 - Teleoperation Mode: for each recyclable object successfully sorted into its corresponding container the points are as follows:
 - Each recyclable material is worth the following points:
 - Metal **3 points**
 - Plastic **5 point**
 - Glass **1 points**
 - There will be a total of 70 Recyclable materials.
 - 15 ½" Steel-ball
 - 20 1-in Foam Color Cubes
 - 35 1" Shooter Marbles

Scaled Drawing:

1. A scaled rendering plan must accompany the robot for evaluation. It scaled plans consist of a three-view drawings that include the major dimensions of the robot.
2. Teams must submit scaled drawings of their robots to your Instructional Assistant on Friday January 18th, 2019 by 4:00 p.m.
 - a. No late submissions will be allowed.
3. The maximum score for the drawings is 10 points.
4. The robot Scaled drawings MUST include following:
 - a. Top, side and front view
5. Each scaled drawing sheet MUST be labeled with the following to obtain full points:
 - a. Team Name, Team Members' Names, School, Specified 1:1 scale and all measurements
6. Drawings must be done by hand or computer generated. Photocopies of your robot will NOT be allowed.



Example of Scale Drawing Side View:



Scaled Drawing Rubric:

Team Name:	School:
Check all that apply: (each bullet point is worth 1 point maximum)	
Labeling: (2 Points)	
<input type="checkbox"/> Are the top, side, and front View scaled-drawing clearly labeled with the Robot Number, Team's name, Students' Names, and School on each page?	
Rendering: (6 Points)	
<input type="checkbox"/> Top, side and front view scaled-drawings include	
<input type="checkbox"/> All of the robot's major measurements and components.	
<input type="checkbox"/> A 1:1 scale key and drawings are at 1:1 scale with present unit measurements.	
Quality:(2 Points)	
<input type="checkbox"/> Each scaled-drawings pencil or ink mark/smudge free, done with excellent quality and pages kept neatly with few or no wrinkles.	
Total: _____/10 points	

Application Video Presentation:

The team will be responsible for developing and producing their own video on the educational topic of the competition and their robot. The video must include the following specifications:

1. Video submissions must be done by sharing the video through google drive to the IV MESA email imperialvalleymesa@gmail.com. Make sure permission is given for viewing of the video through google docs.
 - a. The **due date** is **January 18th, 2019 by 11:59 pm**. No late submissions will be accepted.
 - b. The **email's subject** must state the team's Name and School.
 - c. The **email must state** the team members' names and grades.

Format of the video:

2. The video must be between 60 to 120 seconds long and must be in .MOV or MP4 video format.

The content of the video:

3. The video must contain the following:



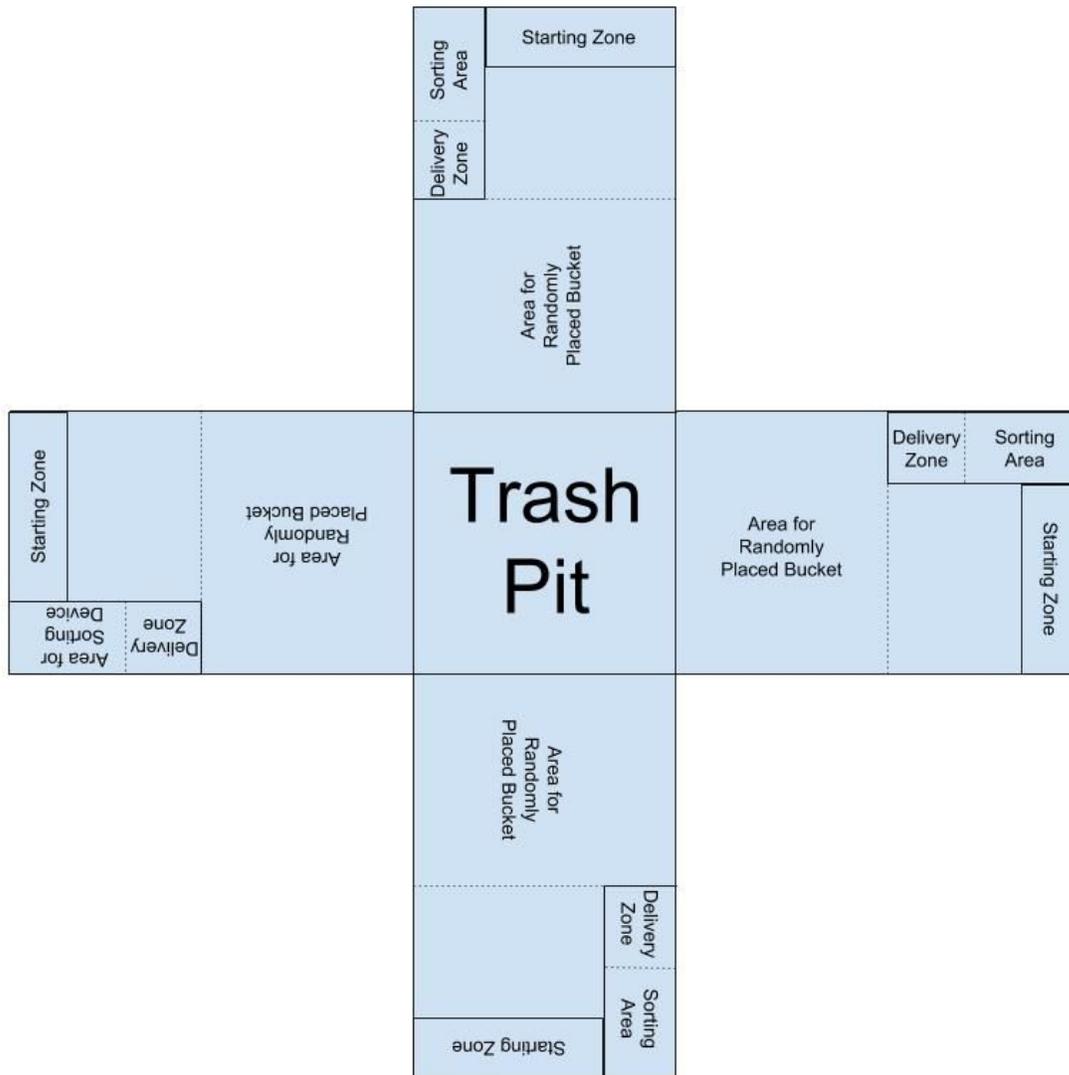
- a. An introductory 5 second segment that displays the team’s name, names of members, school, school logo and [MESA Logo](#) (all together at the same time).
 - b. The video **must** explain your team’s Engineering Design Process pertaining to this competition through an audio recording **and** visual textual display:
 - i.
6. Include a “time-lapse” video demonstration of your robot while completing its tasks on the playing field.
 7. Artwork or images that are not original or for public use are prohibited unless permission has been granted by the author/s. If permission is granted, it must be stated directly under the image/artwork.
 8. The last 5 seconds of the video must **MUST** include proper bibliography for information used in the video presentation. Plagiarism will **NOT** be tolerated and students will receive a “zero” if information is copy pasted.

Video Rubric:

Team Name:	School:
Introduction: (Maximum 1 point each) <ul style="list-style-type: none"> • An introductory 5 second segment of 5 seconds • Does the segment displays the team’s name, names of members, school, school logo and MESA Logo (all together at the same time). ____/2 points	
Video Information Content: (Maximum 1 Point each) <ul style="list-style-type: none"> • Was problem identified? • Does team demonstrate/ explain how they explored the task? • Were some of the design options shared? • Explain some issues you ran into with your first design when you tried it out. • How did you make it better with your final design? ____/5 points	
Visual Creativity: (Maximum ½ Point each) <ul style="list-style-type: none"> • Does the video capture and hold the attention of the observer effectively? • Is the layout of text and images well organized? Is the use of space neat, uncluttered, and very easy to follow? • Does the video have the use of creative visual material? Is the information displayed in a creative way? • Does the team use a variety of methods to display/communicate information ex. Pictures, charts, tables, graphics, recordings, etc.? • Is the audio clear and flows with the content of the video? • Is the bibliography included in the video? ____/3 points	
Total: _____/10 points	



Field Layout:



Resources:

- Waste Management and Recycling https://youtu.be/HjNv_iTsXn8