2022

4-H LEGO Robotics Challenge

Sustainable Shellfish Production

Notes for the 2022 Challenge:

- **A new mat is being created for this year's game. One mat will be provided to each county that registers a team**. Additional mats will be made available if a county has multiple teams for a small cost. Mats should be available around the first of March.
- **One Spike Prime Accessory Kit will be made available to each county which registers a team.** Kits will be available around the first of March.
- Videos on building the mission models will be made available on line in the near future.
- A training will be held in the spring to assist teams with this year's challenge.

Funding assistance for the 2022 4-H LEGO Robotics Challenge is provided through a USDA-NIFA Grant.

United States Department of Agriculture
National Institute of Food and Agriculture

UNIVERSITY OF MARYLAND EXTENSION

IMPORTANT NOTES REGARDING COVID-19

In continuing efforts to keep our youth, families, and volunteers safe in response to the COVID-19 pandemic, all 4-H robotics clubs, related programs, and events must adhere to the current University of Maryland 4-H and local government health and safety protocols. In summary:

LOCATION

4-H Activities may be held outdoors or indoors.

- **Outdoor activities** currently (as of 2/14/22) have no physical distancing restrictions, but the personal space and comfort level of participants must continue to be respected.
- **4-H activities to be held indoors** must comply with their county or city's local school system directives on physical distancing and other requirements.

Please note, some 4-H activities are required to follow additional guidelines (i.e., camp & overnight activities). For questions, please contact your local educator.

SIZE

There are no restrictions on capacity sizes. 4-H activities must comply with local school system directives on physical distancing. All 4-H activities must include at least 2 UME Volunteers or 4-H Faculty/Staff leaders. **Please be mindful of 4-H youth/adult ratios:**

- 1 adult volunteer for every 10 youth ages 8-18.
- 1 adult volunteer for every 5 Cloverbud members ages 5-7.

HEALTH PLEDGE

All youth and adult participants must affirm they are well enough to participate in 4-H activities when signing attendance forms. Individual health pledges will no longer be required.

FACE COVERING

- **Outdoors:** 4-H, as guided by the Maryland Health Department, strongly recommends that all non-vaccinated individuals over the age of 2 continue to wear face coverings in all outdoor settings where physical distancing cannot be maintained.
- **Indoors:** 4-H activities must comply with local school system directives on mask requirements indoors.

DISTANCING & HYGIENE

4-H activities must comply with local school system directives on physical distancing. All 4-H participants must have access to supplies for hand hygiene (hand sanitizer, sink with soap and water, etc.). **Cleaning and sanitizing supplies must be available. High-touch surfaces and shared equipment or materials must be sanitized.**

We thank you for your cooperation as we make all our 4-H programs safe and accessible for everyone!

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2022 4-H LEGO Robotics Challenge

Sustainable Shellfish Production

The goal of the 4-H LEGO Robotics Challenge is to provide a simple LEGO Robotics game for entry level participants. This is done through a mission-based activity where youth design, build and program LEGO robots to solve defined tasks. The activity is performed on a 4' x 4' game mat, using pre-defined mission pieces. Each mission has points assigned, based on achieving a set goal. Although the missions are predefined, the solutions for achieving those missions are very open-ended, and depend on the creativity and skill of the participants. This document defines the rules and operating procedures for the 2022 game. If you have any questions contact Willie Lantz at the Garrett County Extension office at 301-334-6960 or wlantz@umd.edu.

1 Teams and Coaches

Teams will consist of 3 to 8 members. The age range of team members may be defined by the local event organizers. Coaches of teams need to be official UME volunteers. If you are not a UME volunteer, contact your local extension office or the Maryland State Office at 301-314-9070 for information on becoming an official volunteer. Coaches also need to register through Maryland 4-H Online. A link is provided on the Maryland 4-H Robotics Page at https://extension.umd.edu/programs/4-h-youth-development/program-areas/stem. Coaches who are registered will receive updates on the game and competitions. Each team can register multiple coaches. There will be a later registration date for the Maryland State 4-H Robotic Challenge.

2 The Game

Team members will construct a robot, using ONLY LEGO parts. The robot will be controlled by a LEGO Intelligent Brick. The robot will autonomously perform specific tasks. The team will have 2 minutes and 30 seconds to perform as many tasks as possible.

2.1 Competition kit

The competition kit comprises the playing field "mat" and the Mission Models. The mission models are constructed using parts from a LEGO Spike Prime accessory kit of parts. Competition kits can be shared among multiple teams.

2.2 Field Mat

The field mat is a 48” x 48” vinyl banner which is mounted inside a wooden “playing field” for stability. The mat defines the various mission regions of the game, and provides registration marks for positioning mission pieces.

2.3 Playing Field

The field will be constructed on a ½” thick sheet of plywood (48” X 48”) with 2” X 4” (studs) on edge to create a playing area of 45” X 45” (inside the 2x4 frame). The mat (48” X 48”) will be installed between the 2” x 4” edge and the plywood. The playing field can be laid on a table or supported by two sawhorses 28” to 32” tall.

3 The Robot

3.1 Allowed Materials

Robots must be constructed using a single LEGO Intelligent Brick (RCX, NXT, EV3 or a Spike Prime) and any additional official LEGO parts. Non-LEGO parts will not be allowed. The robot must be programmed with compatible software to perform the tasks autonomously.

A maximum of the following motors and sensors may be attached to the robot at any time. This does not include “extra” robot manipulators brought to the table but not currently attached to the robot:

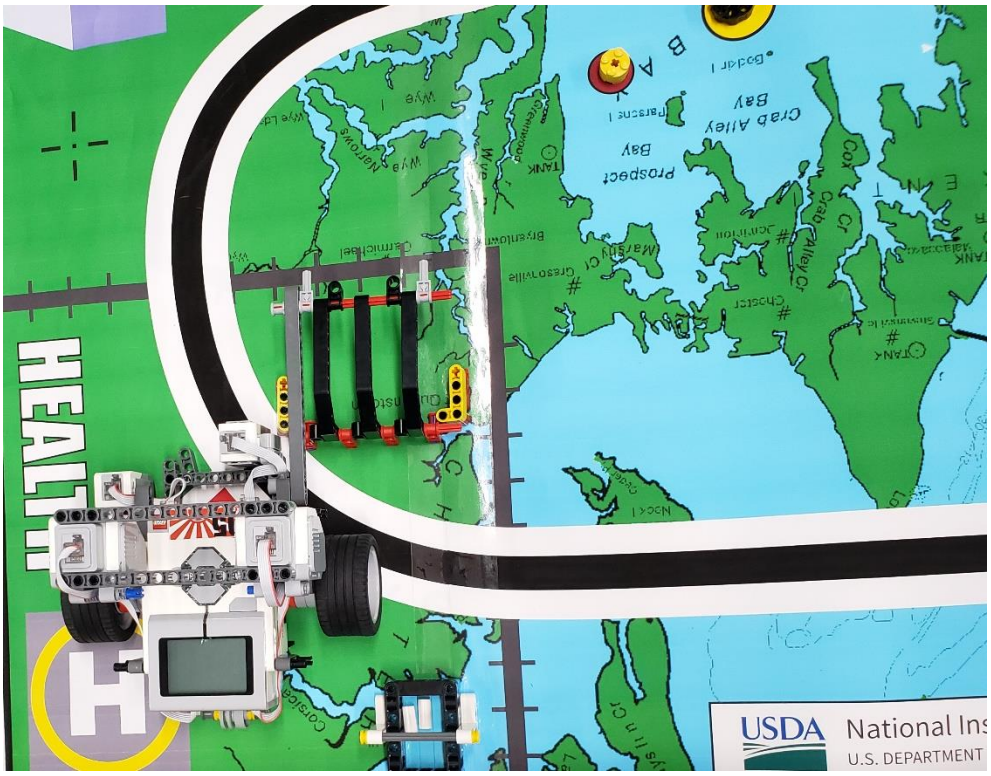
a . 2 x touch/force sensors
b. 2 x light/color sensors
c. 1 x distance sensor
d. 1 x lamp
e. 1 x gyro sensor
f. 3 x motors

The following may not be used:

a. Paint, tape, glue, and oil
b. Non – LEGO stickers
c. Remote controls of any type

3.2 Robot Size

The robot and any attachments must start completely inside of the Base area of the and must not be taller than 12”. After the robot leaves the Base area it may expand to any dimension. For the 2022 LEGO Robotics Challenge, the Base Area is located in the North East Corner of the mat (Health H corner). The actual base area includes the THICK perimeter line, but not the thin lines that extend beyond the THICK line.



3.3 Robot Operation

3.3.1 Robot in Base

While in Base, members my change programs or change parts on the robot. The robot will be considered in Base if any part of the robot is within the Base Area perimeter (see section 3.2)

3.3.2 Handling the Robot

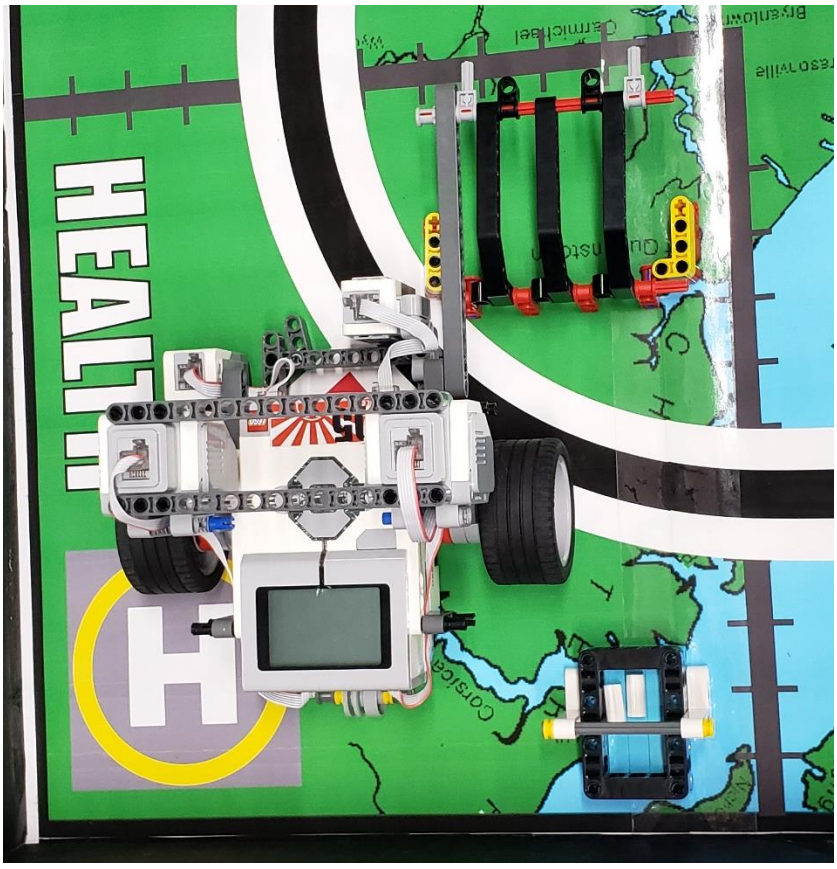
The robot may only be handled by the team members while the robot is in the Base Area. Once the robot completely leaves the Base area, or it makes contact with a Mission Model, then the mission is considered to be “under way”. The member cannot touch, or in any way influence the movement of, the robot or Mission Model until it comes back to Base (any part of the robot breaks the plane of the base) without a penalty. See section 6 for more about Robot Touch Penalties.

Any Mission Objects that are to be brought back to Base must cross into the Base before a member touches the robot. Any mission that was in progress will be terminated if a member touches or in any way interferes with the robot while the Mission Object is still outside of Base**. If scoring pieces are in the control of the robot and have not crossed into base the points will not count and the pieces cannot be used for further missions.**

Teams may re-run the mission, but Mission Models will remain where they are when the robot was touched. The robot may leave Base and return as many times as time allows.

3.3.3 Mission Objects in Base

Several Mission Objects start the challenge within the Base Area. These may be loaded onto the robot or its attachments by hand. Only the robot may move them out of, or back into base. Once they have left the base with the robot, they may not be manipulated by hand until they return back to base.



The mission models that start in Base include the oyster dredge (must be used to harvest oysters) and the set oyster cage. An example robot is shown in this photo.

4 Game Rules

4.1 Mission Models

Mission Objects are constructed from a standard LEGO Education Spike Prime Accessory Kit. Instructions for construction of mission models will be provided on the State 4-H Robotics Challenge web site at:

https://extension.umd.edu/programs/4-h-youth-development/program-areas/stem.

Build instructions are provided in the form of assembly videos. As these videos may be updated to provide last minute changes, the Models shown in the videos supersede images shown in this document. Teams should make every effort to construct mission models according to the videos. A YouTube Video playlist can also be found here: (to be added here). The field(s) at the competition may not be altered by teams. Leeway may be given if discussed with the referee.

4.2 Robot Rounds

Each robot will play three rounds with the highest score of the three rounds counting toward the final award. Each robot round will last for 2 minutes 30 seconds. The round will be started at the referees call and the robot will be turned off by the referee at the end of the round. Teams will be given a minimum of 10 minutes between rounds.

4.3 Robot Operators

Two members will be allowed at the table during the robot rounds. Additional team members must stand in the designated area and may tag in and out during the round.

4.4 Scoring of Mission Objects

All scoring of robot missions is Based on the location of items at the end of the match. If an item is placed in scoring position and then moved by the robot, the item will receive the point for the final resting spot at the end of the match.

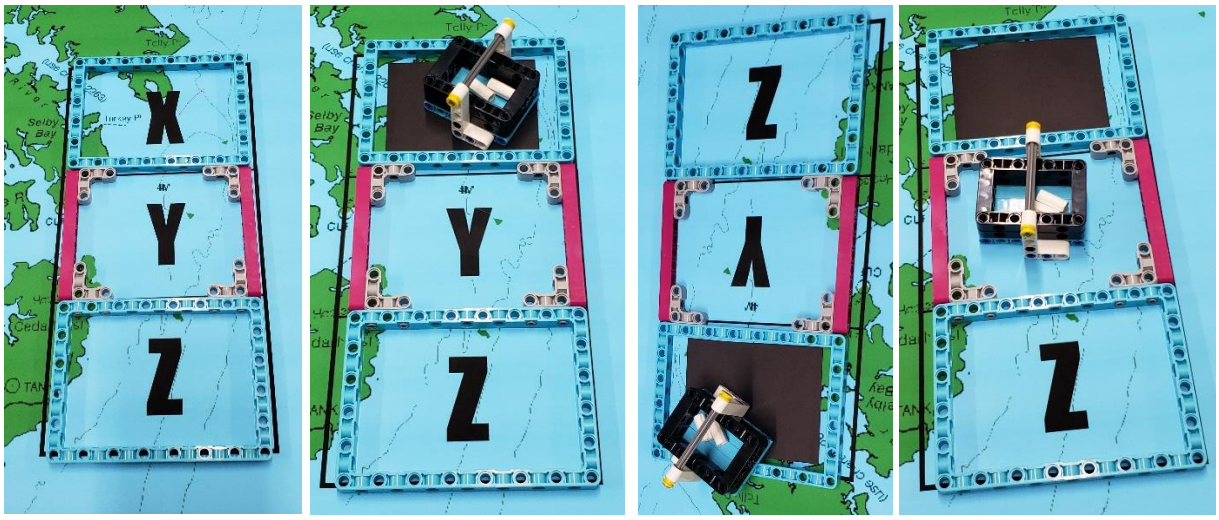
5 Missions

"Missions" are the definition of what the robot must do to gain points. Missions may be performed individually, or grouped together within a single program. Mission may have several different point values depending on the degree to which the mission is completed. Missions are defined in the following sections

5.1 Planting Oysters in the Lease

The robot must deliver the cage of set oysters to the lease area in the bay. The waterman owns three leases. If the robot places the oyster cage in the designated lease, the robot will earn more points. If the team is going to attempt to use the color sensor to detect the correct lease, they must let the referee know before the match starts. The Planting Oyster must be the first mission the team attempts to get the bonus score for placing the oyster cage in the designated lease. Once the team is ready, they will signal the referee who will roll the dice and place black square in the corresponding “lease”. Once the referee rolls the dice the team can not touch their robot till the referee starts the match. If the robot successfully places the oyster cage in the lease with the black square the team will earn 50 points. If the team places the cage in any of the other leases or at anytime other than the first mission attempted, the team will receive 20 points. To earn the full credit for the mission the oyster cage must be in complete contact with the

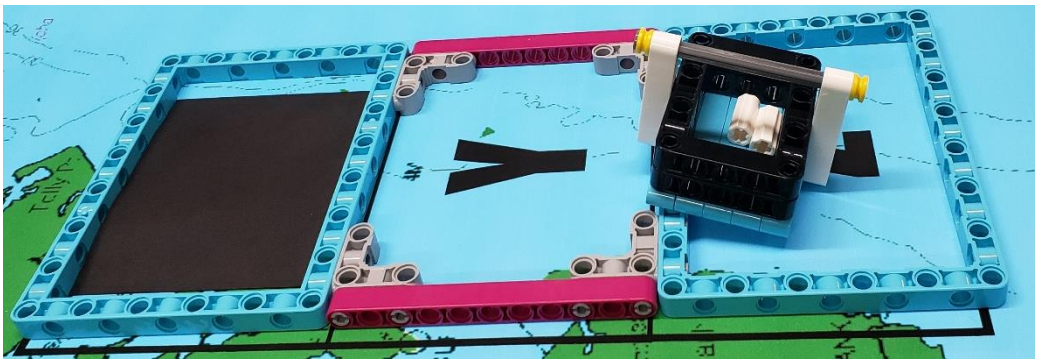
mat/black-square. Any oyster cage that is in the lease but is not completely touching the mat/black-square will only receive half credit for the mission.



A B C D

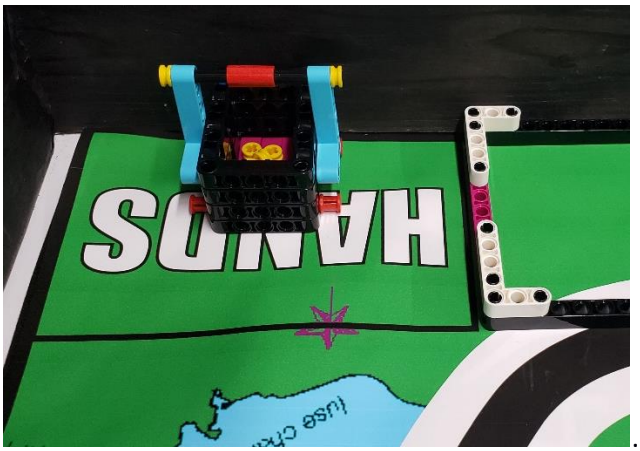
Picture A show the location of the lease on the mat. Picture B shows the oyster cage placed in the designated lease and completely in contact with the black-square (50 points). Picture C shows the oyster cage in the designated lease but not completely in contact with the mat (0 points). Picture D, shows the oyster cage in contact with the mat, but in a non-designated lease (20 points). Picture E, below shows the oyster cage in the lease but not completely touching the mat (0 points).

E



5.2 Collecting Spat from Lab

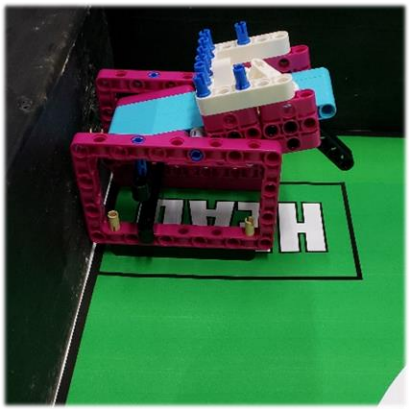
The robot needs to retrieve the spat tank from the lab area and bring it back to base for 10 points.

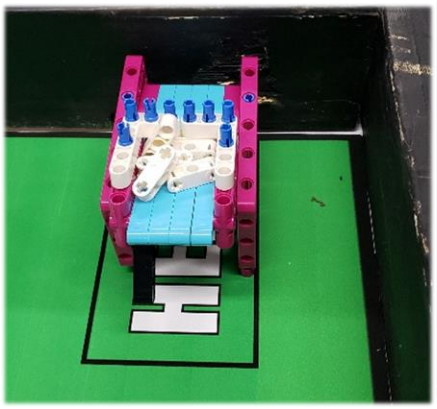


The picture above on the left shows the spat tank in its starting location. The picture on the right shows the spat tank in base.

5.3 Collecting Shells from the Cannery

The robot will collect the shells from the cannery. Each oyster shell in base is worth 5 points.



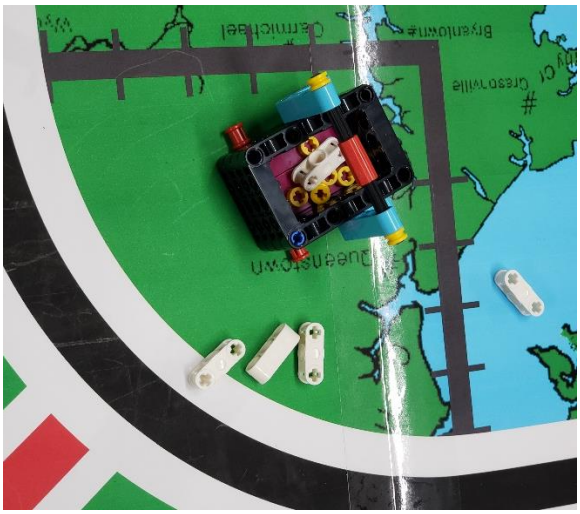


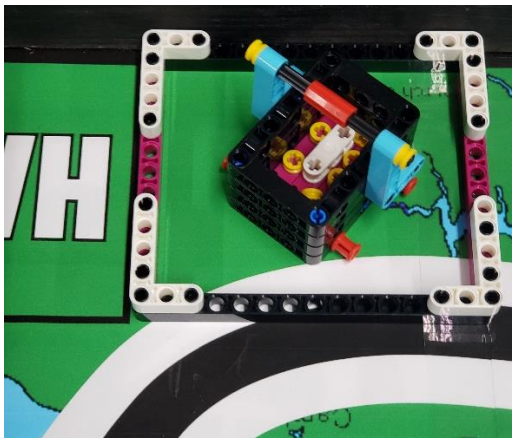
Cannery in starting position

Cannery in dumped position (note shells point values are only if they are in base)

5.4 Delivering Spat and Shells to the Grow-Out Tank

The robot must deliver at least one spat and one oyster shell in the spat tank to the grow-out tank at the lab for 45 points. The spat tank must be completely inside of the grow out tank and in the upright position containing at least one spat and one oyster to receive the points.

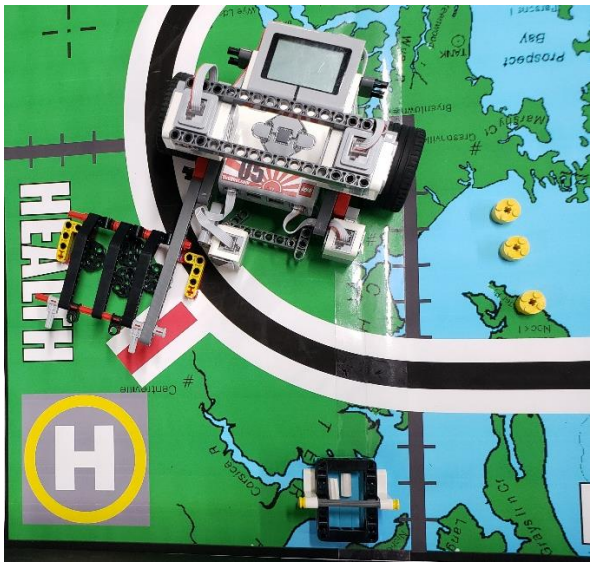




The picture on the left shows the spat tank in base with one oyster shell in the tank, three oyster shells in base and one oyster shell outside of base (20 points for mission 5.3). The picture on the right shows the spat tank completely inside the grow out tank at the lab (45 points).

5.5 Harvesting Oysters

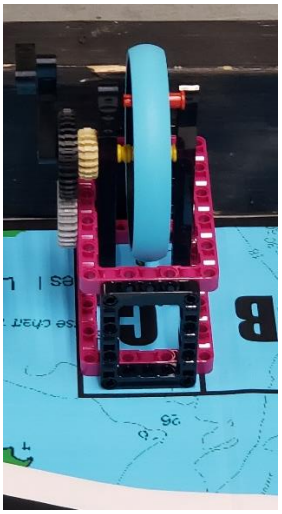
The robot must use the provided "oyster dredge" to collect the large oysters (black) and take back to base for 5 points each or take them to the restaurant (completely inside the Heart H area) for 10 points each. All small oysters (yellow) must remain completely in the bay (in their original starting position, or fully on a blue water area outside of base). If a team removes a small oyster they must return it back to the bay. Any small oyster that is not completely in the bay will receive a penalty of minus 5 points each. Note: The "oyster dredge" must be used without modifications. Parts may be added **only** to attach it to your robot. Referees may request teams to remove any conflicting components.



The picture on the left shows the starting position of the oysters. The picture in the middle shows 4 oysters in base (20 points) and one small oyster touching land (-5 point penalty). The picture on the right shows four oysters in the restaurant (40 points).

5.6 Turning on Water Valve

The robot must turn the water valve at least 90 degrees for 40 points. There is a red peg attached to the valve wheel. This peg will start the match at the top of the valve, next to the vertical black beam. To earn 40 points, the valve must be rotated so the red peg is below the center of the wheel. The valve may be rotated by spinning the wheel or by pulling down the black lever.



This is the starting position for the valve, with the red peg at the top.

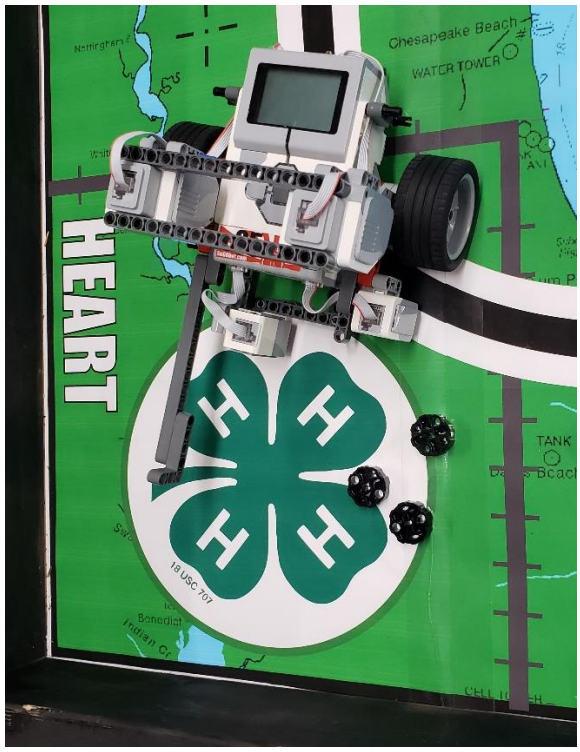
This valve is rotated more than 90 degrees (40 points)

This valve is only rotated 45 degrees (0 points)

5.7 Parking at Restaurant

If the robot is parked fully in the base area at the restaurant at the end of the match the robot will receive 10 points.

Here the robot is fully in the restaurant. (10 points)



Here the robot is only partially in the restaurant. (0 points)

6 Touch Penalties

If the robot is touched outside of the Base it must be brought back to Base immediately and the team will be assessed a touch penalty. To assess the touch penalty, the referee will take one (five total) of the bricks away that are located beside the water valve. The team will receive 5 points for each block that remains on the field at the end of the round.

7 Team Notebook

Each team should document the building of their robot in a journal. Each day that the team meets: record plans for the day, pictures and diagrams of robot building process, and ending reflections. The notebook will be shared with the judges during the technical presentation.

8 Technical Presentation

Each team will be assigned a 10 minute time period prior to the robot rounds to present to a panel of judges their robot's design. The presentation should include information on the team's design features, game strategies and programming. A game table with mission models will be provided. The team may utilize the game table to demonstrate the robot completing missions. A panel of 2-4 judges will rate the team's technical presentation based on the Technical Rubric (Appendix A). The team will be assigned a numerical score between 0 and 100.

9 Service Project

Through the service project, the team should research oyster production and create an educational module about some aspect of oyster production. The educational module can be a presentation, video, book, flyer, game, challenge etc.

The team should share their project with a community organization or in an appropriate manner to help educate the public about oyster production. If a robotic program has multiple teams doing the same or a similar community service projects, be clear in explaining the roles of the team members in conducting the project.

9.1 Project Display

The teams should create a table top display that will explain their service project. The board should be displayed during the competition on the team's pit table and can be used during their presentation.

9.2 Project Presentation

The team will present a 3-5 minute presentation about their project to a panel of judges. The judges have 5 minutes to ask questions

10 Mission Point Scoring summary

Mission	Description	Point Value
5.1 Planting Oysters	If the oyster cage is placed in the designated (black square) lease on the first mission. (Half credit for oyster cage not completely touching the mat) **or** If the oyster cage is placed in the non-designated lease during the first mission or any lease during any mission run after the first mission. Half credit for oyster cage not completely touching the mat)	**50 points** **25 points**
5.2 Collect Spat	The spat tank is completely in base at the end of the round.	**10 points**
5.3 Collect Shells	Shells completely in base at the end of the round	**5 points per shell** **25 points**
5.4 Deliver Spat and Shells to Tank	At least one spat and one shell in the small tank collected from the lab are placed completely inside of the tank at the Lab.	**45 points**
5.5 Harvesting Oysters	Large Oysters (black) in base. Large Oysters (black) completely in Restaurant	**5 points each** **20 points MAX** **10 points each** **40 points MAX**
5.6 Water turned On	The water valve must be turned at least 90 degrees from starting point.	**40 points**
5.7 Robot Parked at Restaurant	Robot must be parked completely in the base area at the restaurant at the end of the round.	**10 points**
Touch Penalties	Referee will remove on block each time the team is assessed a touch penalty (see section 6 for definition of a touch penalty).	**5 points each** **25 points**
Small Oyster Penalty	Any small oyster (yellow) that are not completely in the bay (blue area).	**-5 points each**
		Total Possible: **200 points**

Appendix A - Maryland 4-H Lego Robotic Challenge – Robot Technical Presentation Rubric

Robot Design	Evidence of structural integrity, constructed in a manner to allow for multiple tasks appropriate for the game, efficient use of parts.				
	Beginning (1-point each)	Developing (2 points each)	Accomplished (3 points each)	Exemplary (4 points each)	Score
	O Quite fragile & breaks a lot O Repairs and adding attachments take considerable time O Little use of manipulators O No sensors used for positioning O Very basic robot design	O Frequent faults or repairs O Parts of the robot do not fit well together O Simple manipulators O Limited or no use of sensors O Basic robot design with good balance	O Limited faults or repairs O Parts of the robot fit and function well together O Manipulators are designed and function well O Use of sensors for basic positioning O Robot design is sound and functions well with game	O No faults or repairs needed O Robot is streamlined and functions as a unit O Manipulators are well designed and perform tasks efficiently O Use of sensors for accurate positioning O Robot design is well thought out and performs task every time	
Strategy & innovation	Ability to develop and explain improvement to robot design that happened throughout the season including methods for making decisions and testing. Ability to clearly define and describe team goals and strategies for accomplishing goals. Creation of new, unique or unexpected features that are beneficial in performing the specific tasks.				
	Beginning (1 point each)	Developing (2 points each)	Accomplished (3 points each)	Exemplary (4 points each)	Score
	O Organization AND explanation of the team needs improvement O No clear goals O No clear strategy for accomplishing the mission O Robot has typical features and operates as expected	O Either team organization OR explanation needs improvement O Goals setting is ambiguous O Strategy is unclear O Robot has minimal features that are innovative	O Organization of the team is systematic and well explained O Team has good goals O Team has a clear strategy to accomplish tasks O Robot has features that are innovative that allow it to accomplish goals and strategies	O Organization is systematic, well explained and well documented O Team has document goals O Team has clear strategy to accomplish most/all game missions O Robot has many innovative features which allows the team to accomplish most/all game missions with accuracy	
Programing	Programs are appropriate for the intended purpose and would achieve consistent results, assuming no mechanical faults. Programs are modular, streamlined and understandable with documentation. Ability of the robot to move or act as intended using mechanical and/or sensor feedback (with minimal reliance on driver intervention and/or program timing).				
	Beginning (1 point each)	Developing (2 points each)	Accomplished (3 points each)	Exemplary (4 points each)	Score
	O Program is very basic relying on no feedback from the field O Program is not documented O Program is difficult to understand O Excessive driver interaction needed to aim/set robot before each mission O Robot completes missions infrequently or only after multiple attempts.	O Program is basic relying on little feedback from the field for positioning. O Program documentation is not complete O Program contains inefficient code O Driver must spend time to aim/set the robot before each mission. O Robot completes missions inconsistently or only after a few attempts.	O Program uses field or sensors to determine robot position on the field. O Program is documented and easy to understand O Program uses appropriate code complexity for tasks completed O Driver spends little time aiming/setting the robot before each round. O Robot completes missions consistently most of the time.	O Program uses complex code and sensors to determine position on the field. O Program is well documented and is easy for anyone to understand O Program uses streamlined code. O Robot position at the beginning of the match is not relying on driver aiming O Robot completes missions nearly every time and regardless of field conditions.	
	Over for Comments			Total Score	