



## 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 are not 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!



# 2022 4-H ROBOTICS ENGINEERING CHALLENGE

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**NOTE: Yellow-Highlighted Sections are Updates from Previous Manual Version**

# Maryland 4-H Robotics Engineering Challenge

The Maryland 4-H Robotics Engineering Challenge (REC) provides an opportunity for 4-H members interested in STEM (Science, Technology, Engineering, Math) to participate in a hands-on, team-based activity where they build robots and program them to complete specific tasks. Successful teams will display technical excellence in robot design, engineering, and programming, as well as a high level of skill on the field in competition. The REC theme changes every year and integrates hot topic issues plus 4-H and University of Maryland priorities to bridge connections between youth, UMD, and industry.

Please direct questions and/or concerns to Mark DeMorra, 4-H STEM Specialist, at [mdemorra@umd.edu](mailto:mdemorra@umd.edu), or Willie Lantz, 4-H Robotics Superintendent, at [wlantz@umd.edu](mailto:wlantz@umd.edu).

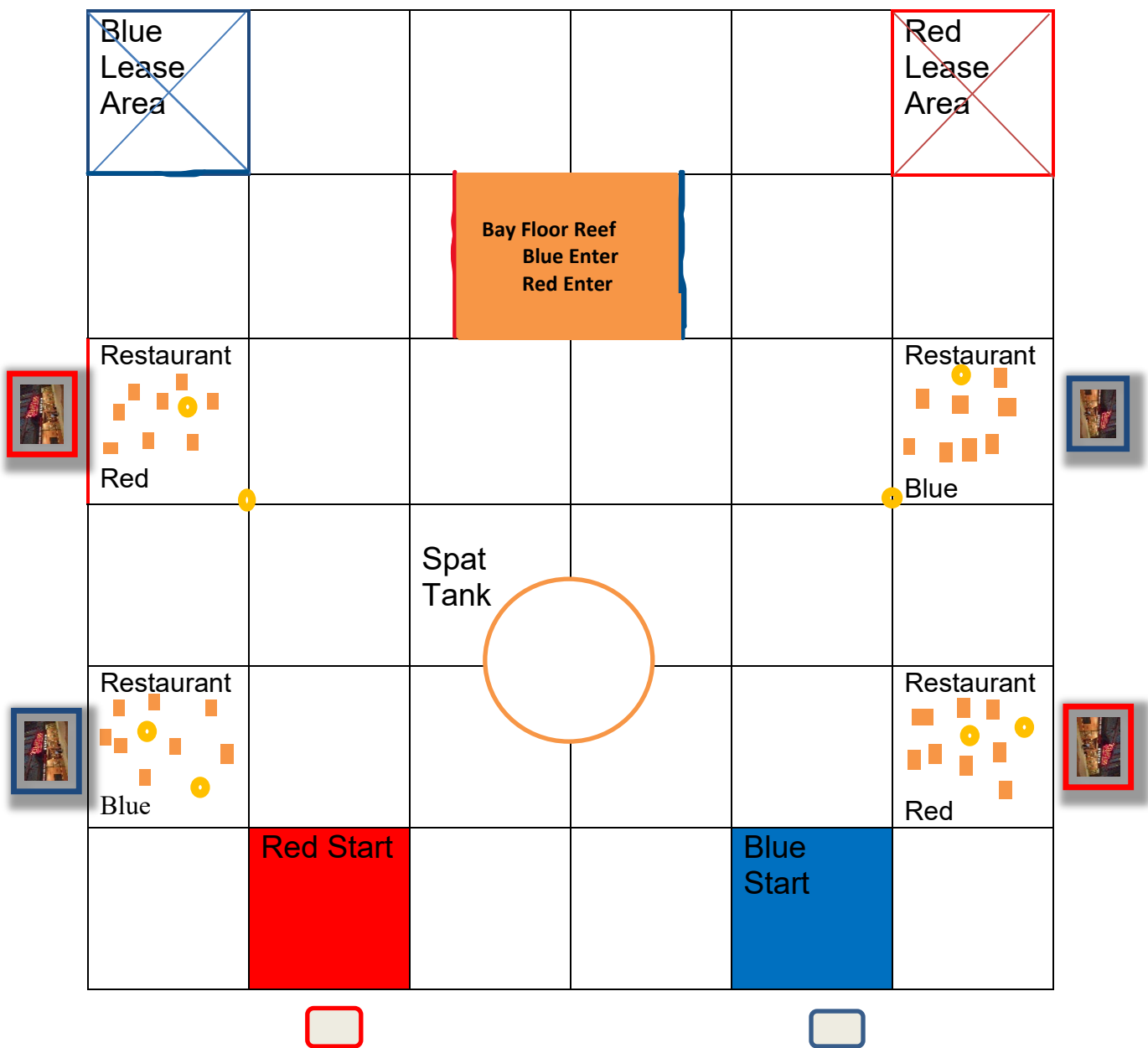
## Background, Theme, and STEM Connections

The theme for the 2022 4-H Robotics Engineering Challenge (REC) is called **AWW Shucks: Sustainable Shellfish Aquaculture for a Cleaner Bay**. The theme was chosen because of the bay's critical connections to Maryland, itself, and our neighbors, and to continue emphasizing our 4-H programming that connects youth with opportunities to learn more about environmental science and the natural wonders the bay provides. The Chesapeake Bay is the largest and one of the most vital estuaries in the United States. It is also a center for regional commerce, cultural influence, entertainment, and food supply. However, the rapid increase in population and tourism, among other factors, continues to threaten the health of the Chesapeake Bay, and thus the people who live and rely on its existence. Correlated, the 2022 National 4-H STEM Challenge will also be themed around climate change and environmental issues that are impacting the lives of Marylanders and all Americans more so every day.

4-H REC teams will be tasked with building a robot using various parts, sensors, motors, and other components in order to complete missions and score points on the REC field. This year's game presents teams with numerous mission opportunities that feature higher potential scores for teams who are willing to take more chances. The game also features an imaging element with some missions that is aimed to simulate what scientists and engineers who work in aquaculture and underwater robotics must consider and deal with in order to perform their research.

Maryland 4-H wants to extend our heartiest thanks and "Great Job!" to the **Frederick County Robo Rangers** for their team's leadership in developing this year's game. The Frederick County Robo Rangers is a 4-H club that meets in Frederick, Maryland and competes in numerous robotics challenges, such as 4-H Lego, 4-H REC, First Lego League (FLL), First Tech Challenge (FTC), and more. The team wishes to extend special thanks to their leader for this project, 4-H volunteer Mark Spurrier, and to Robo Rangers club member Kira Anderson, who was responsible for the core design elements of the game. To learn more about the Robo Rangers, they can be reached via e-mail at [frederick4hrobotics@gmail.com](mailto:frederick4hrobotics@gmail.com).


An image of the full 2022 REC field follows on the next page.



Key:

Shellfish Cage 

Spat 

Pearl 

shell 

oyster 

Figure 1: 2022 REC  
Field-Labeled

## *STEM Connections (Environmental Science and Production Aquaculture)*

The theme of aquaculture and shellfish for the 2022 REC game are part of an initiative by the University of Maryland and other universities to innovate those practices involved with shellfish farm production and the preservation of our environment. Shellfish aquaculture is referred to as the most ecologically sustainable form of aquaculture and has a smaller carbon footprint compared to land farming, while still providing comparable levels of food output. Shellfish aquaculture also provides numerous environmental benefits, such as nursery habitat creation and water filtration, which are critical in areas such as the Chesapeake Bay, which has been highly utilized as a source of food for humans for at least hundreds, if not thousands of years. To improve and maintain the health of the Chesapeake Bay requires experts from numerous fields besides Aquaculture, including Engineering, Biology, Computer Science, Physics, and more.

Annually, the United States imports over 5 million tons of oysters and aquaculture farmers gather over 37 million pounds of catch. In Maryland, aquaculture and associated fields are important parts of the economy, and future population growth depends on a thriving and sustainable aquaculture sector. However, to continue meeting growing demand, greater productivity and increases in efficiency and stewardship are needed, or else production will not remain sustainable, and as has happened in recent decades, shellfish numbers will decrease and risk disappearing entirely. To improve sustainable aquaculture practices, increase harvesting rates, and improve sustainability, new technologies are being developed, including underwater robots. Some are even being modeled after on-land farming technologies, including drones, surveying tools, and GPS. Many are even being worked on here in Maryland by technology companies and the University of Maryland!



The 2022 REC missions reflect the goals of underwater robots and how they must operate to successfully perform the duties they were built for. For example, many underwater robots are developed to study the bottom of the seafloor, which use sensors and imaging tools along with mapping processes that use Artificial Intelligence (AI) to help detect various features. This is especially helpful since normal pictures and imaging are difficult to study on their own due to the depths involved and the lower levels of image clarity in *brackish water*. It is also difficult to study the bottom of brackish regions because they are rarely uniform, meaning great variation in organisms and phenomena can occur within a small area. This makes mapping significantly more difficult, thus determining those regions where the highest and lowest yields of shellfish occur also more difficult. The REC field includes an enclosed Chesapeake Bay Floor Reef Harvest Area where robots can use imaging tools to identify “live” oysters to pick up and then deliver to their starting tile to score points. They can only draw live oysters from their side of this harvest area, however, because shellfish farmers are only allowed to grow and harvest shellfish that they collect from their own *Lease Areas*. They cannot harvest from areas they don’t lease without incurring fines and penalties. Further, according to law, a shellfish farmer can only collect a limited quantity of shellfish per year, because if too many are harvested too quickly, there won’t be enough left in the bay to reproduce and then be farmable in the future. Thus, there is a limit to how many shellfish a REC team can collect, without incurring a *citation*.

Another penalty mirrors issues with the transportation of *spat*, defined as oyster larvae that permanently affix themselves to a surface, such as the sea floor, other oyster shells, bulkheads, or even rocks. If, during the transportation of spat, the robot (akin to a boat or truck) drops the spat on the way to its destination but doesn’t retrieve it, that young oyster will die, and the team will lose points. Further, it isn’t enough to just deposit spat in the designated areas they are to be transported to (*Lease Area* and *Shellfish Cage*). For the oysters to grow and mature, they need something to attach themselves to... in REC’s case, shells. Thus, teams will only score points for depositing spat if they deposit at least one shell in that same area as well.

# Vocabulary, Terms, and Definitions

Aquaculture: As defined by NOAA, “Aquaculture is the breeding, rearing, and harvesting of fish, shellfish, algae, and other organisms in all types of water environments.” This includes seawater, freshwater, brackish water, saltwater, and even on-shore aquaculture with ponds, aquaponics, fish tanks, and more. Aquaculture efforts produced 120 million tons of output valued at \$274 billion in 2019, and being seen as an important source of food and other important organisms in the future, significant research is being done to improve its processes and efforts. Aquaculture is the overarching theme of the 2022 MD 4-H REC game.

Citation: A 30-point penalty assessed to a REC team under the following scenarios:

- Team harvests more than three oysters in a match,
- Team harvests an oyster after the reef has been closed, or
- Team enters or exits through the wrong harvesting area at any point in the match.

This rule reflects real-life laws that aquaculture farmers must consider, which were put in place to ensure that aquatic organisms are not overfished or overharvested, thus meaning they will not be able to reproduce enough during the year to reach previous numbers.

Autonomous Period: The first 30 seconds of a REC match is called the Autonomous Period. As opposed to the Driver-Controlled Period, this period of time is when a team’s robot must operate on its own without the use of human input through the controller. A team will have to write an autonomous code before REC competition day, and can have multiple autonomous codes created to use, depending on each match’s situation, during the competition.

Bay Floor Reef (Harvest Area): The ridge or floor of a body of water, usually made of rock, sand, coral, or other materials. Numerous organisms, such as oysters, sponges, seaweed, algae, and some fish, live on the ocean floor and are called benthos. In the 2022 REC game, it is a 24” X 20” X 21” cardboard box in a wooden and PVC frame, centered on the third and fourth tile of the fifth row and secured to the field by tape. Teams enter and exit the reef through their own side of the box, marked red or blue correspondingly, and cannot drive through the box without incurring a 30-point *Citation*. Inside of the Bay Floor Reef are eight (8) black-painted *Live Oysters* randomly placed throughout.

Brackish Water: General term used to describe bodies of water that are too salty (aka too saline) to be considered freshwater, but not salty enough (or not saline enough) to be considered seawater or marine. The Chesapeake Bay is comprised of brackish water, as are all *Estuaries*. Because the water is brackish, and often contains significant sediment due to the mixing of freshwater and seawater, its clarity is significantly low, making study of its depths more difficult. This is reflected in the REC game through the Bay Floor Reef Harvest Area mission, where a “special camera” is needed to find the live oysters to be collected.

“Closed for the Season:” Term used to describe the situation when four *Live Oysters* have been extracted from the *Harvest Area* by teams, and when teams cannot extract more *Live Oysters* from the area without incurring a -30 point *Citation*. The Referee will announce when this occurs.

Dredging: The process of excavating an aquatic environment, for the purpose of reshaping land or water features, improve drainage, constructing controls structures such as dams, and recovering commercially valuable items, such as marine life or minerals. Dredging can have significant environmental impacts, including water pollution and disturbance of long-established ecosystems, and as such, is closely regulated in many parts of the world.

Driver-Controlled Period: The Driver-Controlled Period follows the 30-second *Autonomous Period* and lasts for 2 minutes. This period will have teams control their robots directly using remote controls that remotely communicate with the robot's electronics to operate. The end of the Driver-Controlled Period constitutes the end of a match.

Estuary: A partially enclosed body of *Brackish Water* that is connected to an open sea and has at least one river or stream flowing into it, one example is the Chesapeake Bay. Estuaries are often the meeting place for sources of freshwater on one end and seawater (or marine water) on the other end, and due to this meeting, have high levels of sediment and nutrients, allowing for them to be some of the most productive animal habitats in the world.

Event Official: Any individual who is leading or assisting with the operation and execution of refereeing, judging, scoring, and officiating a REC tournament is considered an Event Official. Decisions made by them are believed to be unbiased and done using their best judgment. These individuals have been asked to assist in some manner with a REC tournament by, and report to, the 4-H Robotics Superintendent and 4-H STEM Specialist. Questions about decisions made by robot game referees must be brought to their attention immediately following a match, when a referee asks a team to review and sign-off on their score sheet. After a match's scoring has been posted, it is considered final and CANNOT be changed.

Field: The 12ft by 12ft playing area for the REC game. The field consists of the foam tiles and all game elements that are located within the *Field Perimeter*. It is expected that, during the course of a REC match, all robots, robot components, game elements, and scoring elements will remain on the Field or robot and within the *Field Perimeter*.

Field Perimeter: The 1ft tall black aluminum and clear acrylic border of a REC Field, whose purpose is to keep all *Field* elements contained within its borders throughout the game. The Field Perimeter is 12ft in length on each side and can be a VEX VRC Field Perimeter or FTC Field Perimeter from Andymark.

Lease Area: Located in the back corners, each team's Lease Area is outlined with red or blue tape and has a correspondingly colored X in their center. Teams can score points in the Lease Area by depositing Oyster Shells (2 points apiece) and Spat (5 points apiece) inside it by the end of the match.

Live Oysters: Contained within the Chesapeake Bay Floor Reef (*Harvest Area*), they are black 2" X 4" X 3" wooden blocks that robots can collect using their video imaging (camera) devices. 8 begin in the *Harvest Area* at the start of match, but only a maximum of 4 can be taken out, total, by both teams, to avoid overharvesting. Once 4 *Live Oysters* are taken from the *Harvest Area*, it is "*Closed for the Season*," and teams cannot take more out without incurring a *Citation* of -30 points. A team can also only take a total of 3 *Live Oysters*, themselves, before incurring an overharvesting *Citation*. A robot can only hold 2 *Live Oysters* at a time, and holding more will disqualify those from being scored, but they will still count towards the total number taken from the *Harvest Area* and any potential *Citations*.

Mooring: Term used to describe the securing of a boat or other watercraft to land or other secure structure such as a pier or dock. A team can score 10 points in the *Autonomous Period* of a match by Mooring their robot at their team's own entrance (colored red or blue) to the *Chesapeake Bay Floor Reef (Harvest Area)*. To count, the robot must have at least 50% of its treads (but not more than 75%) across the *Harvest Area's* tape at the opening of their side's blind, at the end of the *Autonomous Period*. If a team's robot uses wheels instead of treads, at least one, but not more than two, of their wheels must be across the tape instead.

Oyster Shells: Represented by 2" x 3" x 2" wooden blocks marked blue or red, they are collected from restaurants placed around the field and can be deposited in a team's *Lease Area* for 2 points apiece, or in the team's *Shellfish Cage* for 3 points apiece. To collect points for *Spat* in both cases, at least one

shell must also be present in the same location at the end of match.

Pearls: With 13 located “randomly” around the field, they can be collected by a team’s robot and deposited in their starting tile for 5 points apiece. They are represented by plastic golf ball-sized wiffle balls, and one pearl is always guaranteed to be located at the front corner of each’s team’s farthest restaurant located on their side of the field.

Shellfish Cage (Basket): Located to the outer side of a team’s starting tile, these are 14.44” X 12” X 8.5” plastic baskets that a team can attempt to earn bonus points with by filling their Cage with *Oyster Shells* (normally 3 points apiece in the Cage) and *Spat* (normally 7 points apiece in the Cage) of their color. The team can then deliver and place the Cage in a team’s *Lease Area* to create a shellfish nursery for more points. The Cage must contain at least one *Oyster Shell* and one *Spat* piece **before** it can be delivered to the *Lease Area*. **Teams can only attempt to deliver the Cage to their designated Lease Area within the final 30 seconds of the match.** Successful delivery of a *Shellfish Cage* to the *Lease Area* DOUBLES the points the team earns from depositing *Oyster Shells* and *Spat* in the *Shellfish Cage* itself, meaning *Oyster Shells* there are then worth 6 points apiece in the cage, and *Spat* is worth 14 points apiece in the cage.

Spat (Oyster Seed): Spat is oyster larvae that have attached themselves to a surface. They are represented by 2” long x  $\frac{3}{4}$ ” diameter Pex pipe of each team’s appropriate color. At the beginning of the game, they are located in the team’s *Spat Tank*. Teams can score with Spat by depositing those of their color into their *Lease Area* (2 points apiece) or in their team’s *Shellfish Cage* (3 points apiece) while the Cage is still in the team’s starting tile. Spat must be contained completely inside of the *Lease Area* without breaking the plane of the tile, or inside the *Shellfish Cage* itself, to potentially score. However, in either case, the Spat must **also** be accompanied by at least one *Oyster Shell* in the Cage or *Lease Area*, as appropriate, in order to be scored.

Spat Tank: Represented by a hula hoop near the middle of the field, Spat Tanks contain 10 Pex pipe *Spat* (5 red and 5 blue) and 5 *Pearls* all randomly located within its border. Teams’ robots can only take *Spat* of their own color to score with elsewhere on the field (i.e. starting tile or *Leasing Area*), but the *Pearls* can be scored with by either team.

## Challenge Overview

### *Robot Game Structure*

During each match, two teams will compete head-to-head, and teams will be competing in multiple matches throughout the day. The objective is for a team to score the most points by completing as many of the missions on the field as they can. Points may be scored by collecting and depositing items in the designated scoring areas before time expires. Other scoring mechanisms also exist, and missions have a range in their difficulty, intended to challenge veteran teams while also allowing for new teams to have a chance to compete. With this in mind, teams will need to get very comfortable operating their robot and its attachments with precision and within tight space constraints.

Each match will last for a total of 2.5 minutes and will be divided into two separate timed periods – the Autonomous period and the Driver Control period. The robot must remain in its final resting position at the end of the Autonomous period and cannot be moved until the start of the Driver Control period. More detailed descriptions of each period follow:

1. The Autonomous period: Teams will have 30 seconds to score points with their robot using only

code previously installed on their robot, and without any operator control. Remote controls must be out of the drivers' hands during this period.

2. The Driver Control (Teleoperation) period: At the conclusion of the Autonomous period, drivers from both teams will be allowed to operate their robot by remote control for 2 minutes. At the conclusion of this period, the referee/scorer will calculate the final scores for both teams and declare a winner.

Scores will be tallied by referees and other event officials at the end of the Driver Control period. Scores may not immediately be revealed to teams, but will be posted shortly after a match's conclusion, after scoring officials have verified and entered them into the system.

## *Judging and the Engineering Notebook*

During the course of the season, teams should document their work in an Engineering Notebook, which should summarize the team's entire process of designing, building, programming, and testing their robot. It is expected that teams update their Engineering Notebook *every meeting*. At State Fair, on the morning of the REC Tournament, each team must submit their Engineering Notebook when they check-in that morning. The judges will *not* review Engineering Notebooks before judging rounds begin.

During the day of the REC tournament, each team will have a scheduled time to give a presentation about their work during the season, both technical and non-technical, to a panel of judges. These sessions will last approximately 10 minutes, but teams must leave time for judges to ask questions at the end. It is recommended teams aim to have their presentations last approximately 5 minutes with 5 minutes left for questions. If the judges feel a team's presentation is running too long, they reserve the right to stop the team at whatever point deemed necessary, and the judges will score the team on what they heard and what questions they're able to ask with the time left. The team's Engineering Notebook and their presentation will determine their final judging score. The rubric used by judges to score notebooks and presentations can be found in the appendix of this document.

## *State Fair Competition Structure*

During the State REC Tournament, REC teams will compete in at least 3 matches against other teams of their same age group. Seniors will compete only against seniors, intermediates only against intermediates, and juniors only against juniors. The age group of a team is determined by the age of the oldest member of the team that is competing, and the age group that individual would fall under in Maryland 4-H will be the age group the team, as a whole, will compete in for REC.

The winning team from each match will be awarded 2 match points for a win, with the losing team receiving no points. In the event of a tie, each team will receive 1 match point. Overall match rankings will be determined by the total number of match points awarded to each team.

The highest possible final judging score will be equal to the highest possible match point total a team can earn over the course of the tournament. For instance, if a team had 3 matches during the day, they could possibly earn 6 match points. In this case, the max judging score would also be 6 points. Thus, the highest max combined score a team can earn for the entire competition would be 12 points.

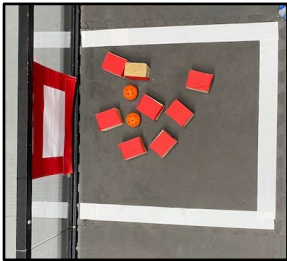
Final tournament rankings will be determined by combining each team's match points with their judging score. The team with the highest combined total will be declared Maryland 4-H REC Champion.

# The Field and Field Elements

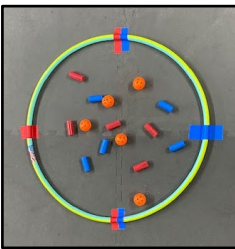
## The Field

Matches are played on a standard 12' x 12' VEX VRC field, with perimeter walls 12" high, and a field surface of standard foam VEX or AndyMark FTC tiles approximately measuring 24" x 24". Before each match, each of the two teams will be assigned to one of two starting tiles – either red or blue. The starting tiles are on one side of the field, indicated by their red or blue color.

## Field Elements



**Restaurants** – Restaurants are located on the far right and left sides of the field on the second and fourth row from the starting tiles. They are marked by white tape and either a red or blue framed 8" x 11.5" picture of a restaurant attached to the side wall. These are the shell collection points and contain 8 shell blocks of the corresponding color and two pearls randomly placed inside except for one prepositioned pearl on the front corner of the farthest restaurant tiles, one per side. A team may enter any restaurant tile to collect pearls but can only collect the shells of their assigned color.



**Spat Tank** - The spat tank is a 24" [Wal-Mart hula hoop](https://www.walmart.com/ip/337790342) attached to the field by tape centered between the second and third row of tiles on the centerline (see Map). Inside the tank are ten (10) Pex pipe "spat" (5 red and 5 blue) and five pearls randomly placed within the circle.

**Part Link:** <https://www.walmart.com/ip/337790342>



**Commercial Shellfish Aquaculture Lease Area** (Lease Area) - Each team has one identified lease area on one of the sixth-row corner tiles. The tiles are outlined with red or blue tape and marked with an "X" of the same color. Teams must be able navigate the entire field to reach their lease area located on the opposite side of the field from their starting tile.



**Chesapeake Bay Floor Reef Harvest Area** - The "Bay Floor Reef" is a 24" x 20" x 21" [Home Depot cardboard box](https://www.homedepot.com/p/The-Home-Depot-24-in-L-x-20-in-W-x-21-in-D-Heavy-Duty-Extra-Large-Moving-Box-with-Handles-HDXLBX/316250863) in a wooden and PVC frame. It is centered on the third and fourth tile of the fifth row using the straight edge of the joint between the fifth and sixth rows as a guideline (see pictures). It is centered approximately 49.5" from each side. The Bay Floor Reef is secured to the field by tape. Each opening is marked with either red or blue and corresponds with the color tile on that opening's side of the field. Teams may only enter and exit the Bay Floor Reef on the side of the box colored to match their starting tile (**NO THROUGH DRIVING**).

Inside of the Bay Floor Reef are eight (8) black-painted oyster blocks randomly placed throughout.

**Home Depot Box Link:** <https://www.homedepot.com/p/The-Home-Depot-24-in-L-x-20-in-W-x-21-in-D-Heavy-Duty-Extra-Large-Moving-Box-with-Handles-HDXLBX/316250863>

**Internet #:** 316250863

**Model #:** HDXLBX

**Store SKU #:** 1006193408

## Scoring Elements



**Spat** - 2" long x  $\frac{3}{4}$ " dia. Pex pipe of each team's appropriate color collected from the spat tank (hula hoop) can be scored one of two ways: 1. by either seeding the shell layer (depositing the spat in an area where there are shells) in the lease area, or 2: placing their spat in the team's shellfish cage (basket) while it is still in the team's starting tile. Spat must be contained completely inside of the lease area without breaking the plane of the tile or shellfish cage **with shells** to be scored.



**Oyster Shells** - Wooden blocks made from 2" x 3" x 2" board (Actual Size: 1.5" x 2.5" x 2" each), marked with blue or red, are collected from restaurants placed around the field and deposited completely within the team's lease area of the appropriate color.



**Live Oysters** - Wooden blocks made from 2" X 4" X 3" board (Actual Size: 1.5" x 3.5" x 3" each), painted black, begin the match inside of the Chesapeake Bay Floor Reef (Harvest Area), represented by a 24" x 20" x 21" [Home Depot cardboard box](#). This is to indicate these oysters would not be visible directly by humans on land. Due to such, the Live Oysters can only be harvested from the Bay Floor Reef by using a robot's video imaging to score points. A robot can hold only a maximum of 2 Live Oysters at a time. Holding more than 2 at a time will disqualify those from being scored, but will still count towards the total number taken from the Harvest Area and any potential citations.



**Pearls** - 13 round plastic wiffle golf balls (pearls) will be placed randomly throughout the field in various elements. One pearl will be placed on the front corner of a team's furthest restaurant tile on the same side of the field as their starting tile. This pearl is positioned to allow teams an opportunity for scoring during the autonomous period.

**Part Link:** <https://www.walmart.com/ip/seort/102641603>

**Manufacturer Part #:** WM122



**Shellfish Cage** - Each team will have a 14.44" X 12" X 8.5" [plastic basket from Wal-Mart](#) placed outside of the field at the team's starting tile. A team may choose to attempt to earn bonus points by filling their cage with shell and spat of their color, then delivering and placing it within the plane of the team's lease area to create a shellfish nursery for future harvesting. The cage must contain at least one shell and one spat before it can be delivered for the bonus. **Teams can only attempt to deliver the cage to their designated lease area within the final 30 seconds of the match.**

**Part Link:** <https://www.walmart.com/ip/seort/166906356>

**Manufacturer Part #:** MS85-361-018-75



**Mooring on the Bay** - During the autonomous period only, teams may also opt to moor (park) their robot at the entrance Chesapeake Bay Floor Reef (Harvest Area) by positioning the robot with at least one but not more than two wheels or 50% of their treads on or across the tape at the opening of the blind.

# Challenge & Game Rules

## *Robot Rules*

1. Robots can weigh a maximum of 20 lbs.
2. Robots may be constructed using a wide variety of materials. Creativity is encouraged! Legos, VEX robotics parts, FIRST components, plastic, cardboard, duct tape, fasteners of various types, etc. are all permitted.
3. Components that pose risk of harm to an opponent's robot are not permitted, even if the risk is unintentional or rare. This includes, but is not limited to, sharp, explosive, radioactive, or liquid components. Robot inspectors, judges, and referees all will be monitoring for these potential risks and have the authority to disqualify a robot from competing until identified issues are fixed.
4. At the beginning of a match, no robot may exceed 18 inches in any dimension, height, width, or length. Robots identified as being too large will be required to reduce their size before being able to compete.
5. Once a match begins, a robot may expand in size but may not exceed 24 inches in length, width, or height. Teams are urged to use common sense when designing robot expansions.
6. No component of a robot may be intentionally detached during a match. This can present a safety hazard.
7. The robot's power source CANNOT exceed a total of 12 volts.
8. The total capacity of the robot's power source CANNOT exceed 6000 mAh.
9. During a match, robots MUST be controlled wirelessly. No tethered or wired connections are allowed.
10. A robot's Autonomous program, if it has one, MUST be able to be started remotely by a team. After being placed in its starting position on the field, touching the robot or its components in any way to start it, change its programming or operation, or otherwise physically control it by hand in some manner, is not allowed until after event officials signal it is clear for robots to be removed. Starting and/or controlling robots by hand in this manner could present safety hazards.
11. Any microprocessor may be used in the robot's design.
12. Any wireless controller may be used, as long as the setup allows for the robot's operation in Autonomous and Driver Control to be done remotely, in accordance with Robot Rule 10 above.
13. A robot can have a **MAXIMUM** of 10 motors and/or servos total.
14. On Challenge Day, all robots must be inspected before they will be permitted to compete in any match. Any issues the inspection judges find with a robot design or setup must be rectified first before it is allowed to compete.

## *Participation Restrictions*

1. 4-H REC Teams may consist of 3 up to 8 4-H youth members total.
2. All team members MUST be enrolled youth in 4-H Online in order to participate in REC at State Fair. Failure to be an enrolled 4-H member, paid in full, and in good standing will result in those individuals not being able to participate in the contest in any form.
3. Each group of youth must have two certified 4-H mentors and/or volunteers established to compete and remain in compliance with established 4-H program rules and protocols.
4. Coaches and Mentors **are** allowed to run, assist, and/or oversee more than one 4-H REC team.
5. A team's age group designation will be determined by the oldest member of the team. The age groups are as follows (Note: age is determined by a child's age as of 1/1/2022)
  - 5.1. Senior Age Group: 14+ years
  - 5.2. Intermediate Age Group: 11 through 13 years
  - 5.3. Junior Age Group: 8 through 10 years

## *Safety Rules*

1. Each team in the pit areas and/or at the field during a match must wear safety glasses. NO EXCEPTIONS!
2. If a robot becomes disabled or behaves erratically, an event official may authorize a team member to enter the field of play and shut off the robot. This is the ONLY time a team member may be allowed to enter the field while play is ongoing. Penalties may be applied if team members enter the field without permission by an event official, while a match is ongoing.
3. Robots that repeatedly or purposefully damage other robots and/or the field or field elements may be removed from the tournament by an event official.

## *General Challenge Rules*

1. All decisions regarding scoring and rules violations are made by event officials. Every effort will be made to ensure matches are fairly and evenly officiated. Concerns about match scoring, penalties, and violations must be brought to the attention of event officials at the end of the match in question, and before the robots are removed from the playing field.
2. Unless given explicit permission by an event official, team members must remain in the designated driver/team areas marked off behind the starting tiles for the duration of a match.
3. At no point during a match may anyone other than a teammate at the field give coaching or instruction.
4. Each match will last a total of 2 minutes and 30 seconds: 30 seconds for Autonomous and 2 minutes for Driver Control.
5. Each team is permitted to have a maximum of three team members at the field during a match: a Pilot, a Co-Pilot, and coach. Team mentors are not allowed at the field during matches.
6. After robots have been setup on the field and event officials have given the “ready” signal, team members CANNOT enter the field or change the position of their robots without explicit permission from the officials.
7. One of the three designated team members will be allowed to use an iPad, cell phone or similar device programed to a remote camera attached to the robot to provide the driver for directions completing the designated missions. This is only permitted if the team has a remote camera attached at the start of the match. Devices must be reviewed and approved during the robot inspection prior to the start of the match.
8. During each match, a countdown timer will be clearly visible to all teams competing in the current match.
9. Event officials may be encouraged, but are not required, to give a countdown in the closing seconds of each match.
10. A buzzer sound plus a signal from an event official will indicate time has expired for each match. At this point, teams must IMMEDIATELY set down their controller to make it obvious they are no longer operating their robot. Any missions completed after the 2.5 minute period will not count towards the scoring.
11. If a robot malfunctions at the conclusion of a match such that the robot continues to operate, teams must receive an “OK” from the event official before manually disabling their robot
12. If a team continues to operate their robot after time has expired, an event official will give a Warning for the first violation. Additional violations may result in a team being disqualified from the current match and subsequent matches.
13. If and only if extreme circumstances arise that compromise the integrity of the game, as decided by event officials, the decision to replay a match or a portion of it may be made.

## *Autonomous Period*

1. The Autonomous period will last for the first 30 seconds of the match.
2. If neither team has an Autonomous program, a match will proceed directly to the 2-minute Driver Control period.
3. 10 points will be awarded to the team that scores the highest during the Autonomous period.
4. In the event of a tie at the end of Autonomous, both teams will be awarded the 10 bonus points.
5. Teams are recommended to use a VEXNET match controller or the FTC Robot Controller app to stop their Autonomous program or must have another pre-approved method to stop their robot's Autonomous function immediately upon expiration of the 30-second Autonomous period.
6. **Incidental** contact between robots is permitted during the Autonomous period. **Intentional** contact is not permitted in any form and may result in penalties being applied.
7. During the Autonomous period, a team must not handle their remote control, so as to ensure that no driver-controlled operations are happening during this time.
8. Teams may be asked at any time by an event official to demonstrate proper functionality of their Autonomous operation. Failure to do such may lead to disqualification.
9. Once the Autonomous period has begun, teams may not touch their robot for any reason unless they have received explicit approval from an event official.
10. **Autonomous operations can only occur on each team's designated side of the field as assigned by their starting tile.** Any scoring items collected from the opposite side of the field, as defined by the centerline of the third and fourth tiles between the starting areas, will not be counted during the autonomous period.
11. A team may terminate their Autonomous operation at any time during the Autonomous period. They must indicate to an event official that they are doing such beforehand.
12. Once an Autonomous program is terminated, teams may not resume Autonomous operation for the rest of that match.
13. If a robot continues operation past the end of the Autonomous period, any missions it completes after the 30-second time will NOT be counted for points. The first time a team's robot does this, they will be given a Warning. At the 2<sup>nd</sup> instance, their robot will be disqualified from participating and scoring in the Autonomous portion of matches for the rest of the competition.
14. Failure to comply with the rules in this section will result in an immediate disqualification from the match at the discretion of an event official.
15. At the conclusion of the Autonomous period, an event official will calculate the score of each team and announce the winner of the Autonomous bonus points. **It is during this time that teams may ask permission to enter the field if manual switching from Autonomous to Driver Control modes, if required. Teams may not enter the field until permission is granted.** Teams may not move or reposition the robot or any other game piece in any way, or they will be penalized by the removal of the impacted scoring pieces and the loss of any bonus points scored. **Teams must declare this requirement to the event official prior to the start of the match.**
16. During the Autonomous period, teams CANNOT cross the midline of the field into their opponent's half of the field (see figure 2). **The penalty is the offending team will receive no autonomous points, and the opposing team automatically receives the 10-point autonomous bonus,** regardless of their autonomous score (even if 0). If both teams cross the midline, no autonomous points will be scored by either team and no bonus will be awarded.

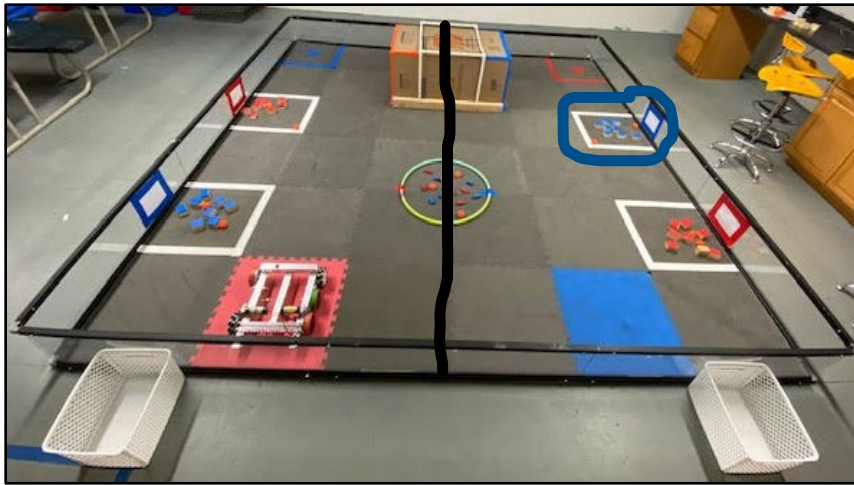


Figure 2: Teams must stay on their side of the midline (black line) during the autonomous period. A pearl will be prepositioned on the field at the front corner of the team's restaurant located on their half of the field, closest to their starting tile (circled in this picture for blue).

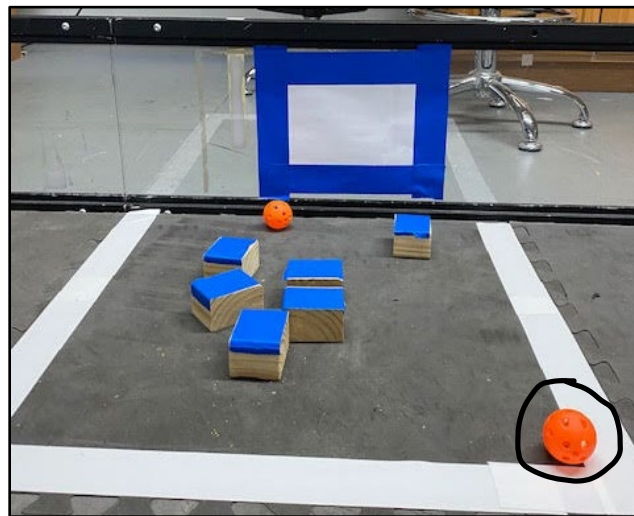
## Driver Control Period

1. The Driver Control period will last for 2 minutes.
2. During Driver Control, each team must control their robot exclusively through wireless controllers.
3. Controlling the robot using wired or tethered means is not permitted.
4. Each team may have a maximum of 2 drivers present during any single match.
5. During the Driver Control period, teams may not touch their robot for any reason unless the team has received explicit permission from an event official to do so.
6. In general, teams may not make contact with their opponent's robot during Driver Control.
7. During Driver Control, incidental contact between robots may happen, but is frowned on. Repeated incidents of robot contact may lead to penalties and/or other actions by event officials.
8. During Driver Control, the following are NOT permitted for any reason: pushing your opponent's robot, pinning your opponent's robot, restricting movement of your opponent's robot in any way.
9. On the first violation of rules regarding robot contact and restricting the movement of opposing robots, the referee will issue the offending team a Warning. Subsequent infractions by the same team will result in disqualification from a match, and the win being credited to the offended team.
10. Robots are not allowed to enter the circular area identified as the Spat Tank. A foul occurs if one or more wheels or a section of tread crosses the hoop into the center of the ring. Teams will be issued a warning for the first offense. In the event a team commits a second offense or performs any action that damages or forcefully dislodges the field pieces, all spat pieces in scoring position for that team would be removed at the end of the match and not be counted in scoring.
11. At the conclusion of Driver Control, teams may not touch, move, or otherwise handle their robot until granted permission from an event official. This is to ensure final scoring is done accurately.

## Match Scoring

1. Before scoring is begun at the end of the match, any robot in contact with a field element may be moved by an event official in order to break contact between the robot and field element.
2. Teams may ask for scoring or rules clarification before removing their robot from the field of play.
3. Once the signal has been given for robots to be removed from the field, all scoring decisions are final and cannot be changed.

4. Teams may not enter the opposing team's starting tile or lease area and cannot move or "unscore" any element once an opponent has properly placed it in an appropriate scoring position.
5. Autonomous Scoring:
  - Teams may collect and place any scoring element or position their robot at any location on their side of the field. All scoring elements must be properly placed in the appropriate scoring area to earn points. Points will ONLY be tallied at the end of the match, with the arrangement of the field and the scoring elements used at that time.
  - A single pearl will be positioned resting on the field at the front corner closest to the starting tile of the same-colored restaurant as an autonomous target.
  - Teams may also opt to moor (park) their robot at the entrance to the Chesapeake Bay Floor Reef (Harvest Area) by positioning the robot with 25% of their treads (if applicable) OR with at least one wheel, but not more than two, on or across the tape at the opening of the blind. Teams that have successfully parked their robots at this location at the end of the autonomous period will earn 10 points.
  - The team that scores the most points at the end of the 30 seconds win the autonomous period and 10 bonus points.



*Figure 3: A close-up view of the restaurant tile with the prepositioned pearl as circled in the figure above.*

6. Collecting Shells - Shells may be collected and score by either depositing them in the team's designated lease area or by placing them in the shellfish cage located at the team's starting tile. Each team has 16 shells marked with their color located at the two restaurants identified by the same color. Shells placed in the team's lease area are worth 2 points each. Shells placed in the team's shellfish cage are worth 3 points. Shells deposited in the wrong-colored lease area are worth 0 points.
7. Collecting Spat - Once oyster larvae attach to structure of the shell bed they are known as spat. Spat may be collected from the Spat Tank. Each team may collect up to 5 spat pieces of their color and deposit in either the team's lease area or shellfish cage. **There must be at least one shell in the same scoring position for the spat to be scored.** Spat placed in the lease area are worth 5 points and spat placed in the team's shellfish cage are worth 7 points. Since these pieces represent the next generation of oysters, they must be treated with care. Teams will be penalized 3 points for each spat piece of their color not in the breeding tank, a starting tile, a scoring position or in control of a robot at the end of the match. Robots cannot drive into the spat tank. Penalties can also be assessed for entry into the spat tank as described above in rule 10 of the Driver Control Period section.

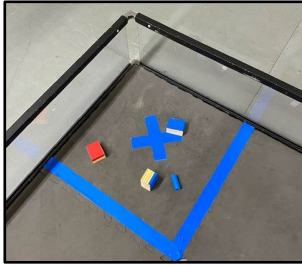


Figure 4: Scoring Shell and Spat in the lease area. This example would be 9 points (4 pts for 2 shells, 5 pts for 1 spat). The red block does not count for any points because it is in the wrong area.



Figure 5: Scoring Shell and Spat in the shellfish cage. This example would be 13 points (6 pts for 2 shells, 7 pts for 1 spat).

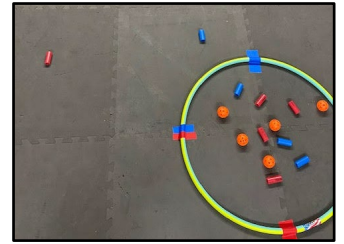


Figure 6: Spat not in an approved location at the end of the match are worth a 3 point deduction for each piece out of place. In this example both blue and red teams would lose three points each.

8. Oyster Harvesting - Teams may use a remote camera mounted on their robot to find and collect up to three (3) Live Oysters during the course of the match and return them to their starting tile. Drivers may receive verbal directions from the camera operator to find and harvest the oysters, but team members may not move around the field to directly see placement of the Live Oysters in the Harvest areas by sight. If robots enter the box, they must enter, exit, and harvest only from their designated color's side of the field. Live Oysters collected and returned to the team's starting tile score 20 points each for a maximum of 60 points. **No more than four (4) total oysters may be harvested during a match. Once the fourth oyster is harvested, the reef is closed for the season.** Teams must be aware of the number of oysters harvested and not overharvest. Teams that harvest more than three oysters, harvest an oyster after the reef has been closed or enter or exit through the wrong harvesting area at any point in the match will receive a citation and be deducted 30 points (-30).

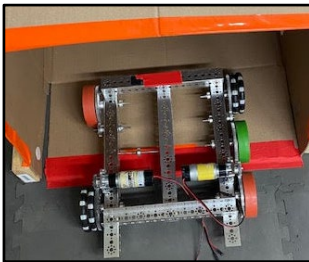


Figure 7: This red robot is entering the Bay Floor Reef on the correct side and may begin to harvest oysters.

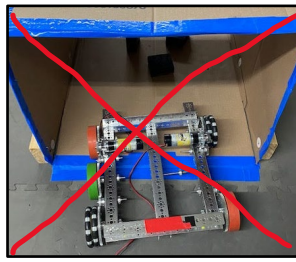


Figure 8: This red robot has entered the Bay Floor Reef on the wrong side. This is a penalty and a 30 pt. deduction.



Figure 9: An example of an oyster and a pearl in a scoring position. This would be worth 25 points. (20 pts for the oyster and 5 pts for the pearl.)

9. Pearl Collection - The pearls are strictly for bonus scoring and if collected and returned to the team's starting tile by the end of the match are worth 5 pts each for a maximum of 65 points. Teams can retrieve pearls from the Spat Tank, any restaurant area, or any neutral area of the field. Teams may not take pearls from the opposing teams starting tile or lease area because this may interfere with other scoring elements. However, if a team knocks a pearl out of their own area into a neutral space the pearl is again available for collection by either team.

10. **Delivery of Shellfish Cage Bonus-** A bonus equal to the total score of the basket contents will be awarded to successful teams who deliver the shellfish cage to their team's leasing area in the corner of the field, during the final 30 seconds of the match. **Example:** two shells and one spat scored in the cage is normally worth 13 points. If the cage with them in it is delivered and properly placed in a team's lease area, it would then be worth 26 points total. Cages not in the lease area by the end of the match will not receive the bonus. **Each team must declare their intention of attempting this bonus mission by placing the cage on the field, clearly making contact with the team's starting tile prior to the start of the match.** The cage must remain touching the team's starting tile until the final 30 seconds of the match. Teams will not be docked points for any scoring items properly stored in the cage at the end of the match, regardless of the cage's location in the event of a failed delivery attempt. **If the cage is improperly placed or prematurely moved from the starting tile, it is considered out of play and points contained within will not count.**



Figure 10: Field set up with Shellfish Cages in pre-match position.



Figure 11: Correct shellfish cage placement: Cage must be placed in contact with some portion of the starting tile at the beginning of the match to be eligible for bonus points. Once placed, it may not be moved from the starting tile until the final 30 seconds of the match.

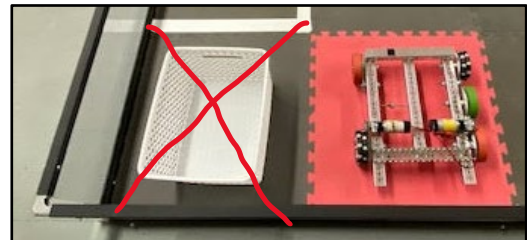


Figure 12: Incorrect shellfish cage placement: If the cage is improperly placed or prematurely moved from the starting tile it is considered out of play and cannot be used.

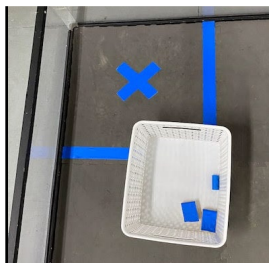


Figure 13: Shellfish Cage in a correct scoring position for bonus. Note at least 1 Oyster Shell and 1 Spat piece inside



Figure 14: Shellfish cage in an incorrect scoring position.

# Appendices

## Referee Scoring Sheet

TEAM NAME: \_\_\_\_\_ Match Number: \_\_\_\_\_ **RED** or **BLUE**

| MISSION   | DONE?<br>YES/NO | QUANTITY (IF<br>APPLICABLE)  | POINTS +/- |        | MULTIPLIER | TOTAL |
|---|-----------------|------------------------------|------------|--------|------------|-------|
|   |                 |                              | AUTO       | TELEOP |            |       |
| Collect shell and spat and deposit in <u>lease area</u> (2 Points per shell in lease area, 5 points per spat in lease area. **There must be at least one shell in lease area to score spat**)               |                 |                              |            |        |            |       |
| Shell   |                 |                              |            |        | X 2        |       |
| Spat  |                 |                              |            |        | X 5        |       |
| Collect shell and spat and deposit in <u>shellfish cage</u> (3 Points per shell in cage, 7 points per spat in cage. **There must be at least one shell in the cage to score spat**)                         |                 |                              |            |        |            |       |
| Shell - <u>A1</u>   |                 |                              |            |        | X 3        |       |
| Spat - <u>A2</u>  |                 |                              |            |        | X 7        |       |
| Harvest oysters from Bay Floor & deposit in starting tile (Max 3 per team, 20 points each, 60 points total) Citation for overharvesting or entering Bay Floor Reef from wrong side (-30 points)             |                 |                              |            |        |            |       |
| Oysters Harvested   |                 |                              |            |        | X 20       |       |
| Citation  |                 |                              |            |        | X -30      |       |
| Shellfish Cage filled with both shell and spat of the appropriate color and <u>placed in lease area</u> . (Bonus points=Cage total points above=A1+A2, <b>ONLY</b> awarded if cage is in team's lease area) |                 |                              |            |        |            |       |
| Cage Delivered  |                 | Quantity same as A1/A2 above |            |        | X1         |       |
| Pearls collected and stored in starting tile (5 points each/65 points max.)   |                 |                              |            |        |            |       |
| Pearls  |                 |                              |            |        | X 5        |       |
| Autonomous Period: Mooring robot at Bay Reef = 10 points, Leader at end of AP = 10 Points, Tie=10 Points for both teams   |                 |                              |            |        |            |       |
| Mooring at the Bay Reef   |                 |                              |            |        | X10        |       |
| Autonomous Period Bonus   |                 |                              |            |        | X10        |       |
| Penalty for Spat <u>not</u> in Spat tank, starting tile, robot or scoring area (-3 per corresponding color only)  |                 |                              |            |        |            |       |
| Spat misplaced  |                 |                              |            |        | X -3       |       |
| TEAM MEMBER INITIALS  |                 | TOTALS:                      |            |        |            |       |

| <i>Judging Rubric</i>                  |   | <b>Awarded Points</b> | <b>Possible Points</b> |
|--|---|-----------------------|------------------------|
| <b>Quality of Display Elements</b>     |   |                       |                        |
|  | Visual elements were well organized.  |                       | 5                      |
|  | Visual elements were helpful (i.e. not just "eye candy").   |                       | 5                      |
|  | <b>SECTION TOTAL:</b>   |                       | <b>10</b>              |
| <b>Quality of Presentation</b>         |   |                       |                        |
|  | Each team member spoke and information presented matches what is recorded in Engineering Notebook.  |                       | 5                      |
|  | Team clearly presented overview and technical information about major subsystems of robot (scoring mechanisms, drivetrain, choice of materials, battery info, power supply, gear ratios, etc.).             |                       | 10                     |
|  | Team provided clear and detailed explanation of code and programming.   |                       | 10                     |
|  | Team provided an explanation of design process, problem solving process.  |                       | 10                     |
|  | Clearly demonstrated understanding of game, rules, and strategy.  |                       | 5                      |
|  | <b>SECTION TOTAL:</b>   |                       | <b>40</b>              |
| <b>Quality of Engineering Notebook</b> |   |                       |                        |
|  | Each team member has a brief biography in notebook.   |                       | 5                      |
|  | The team includes information, which matches what is included in their presentation, about their service projects throughout the year that align with the goals and priorities of MD 4-H and 4-H REC.       |                       | 10                     |
|  | The team provides a financial worksheet that clearly shows expenditures for design and construction.  |                       | 5                      |
|  | The team clearly demonstrates & records their process of robot design, building, programming, and testing, including goals, important milestones, significant changes, evaluation and testing methods, etc. |                       | 15                     |
|  | The team clearly demonstrates the problems they identified, the work they did to solve each particular problem, the testing methods used to verify the solutions, and adequately explained the resolutions. |                       | 15                     |
|  | <b>SECTION TOTAL:</b>   |                       | <b>50</b>              |
|  | <b>GRAND TOTAL</b>  |                       | <b>100</b>             |

