Company Name: Milton SLS
RANGER CLASS
BC High & Milton High
Boston MA, 02186

Team Members:	**Grade, School**	**Role**
Finn Suppelsa	Grade 9th, BC High School	CEO
Henry Synnott	Grade 9th, BC High School	CTO, Box Technician/Pilot
Philip Synnott	Grade 11th, BC High School	COO/Tether Technician
Ian Lundeen	Grade 9th, Milton High School	CMO/CCO

Team Mentors

Jimmy Suppelsa	Mentor

ABSTRACT

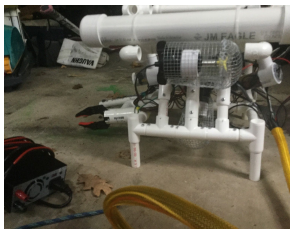
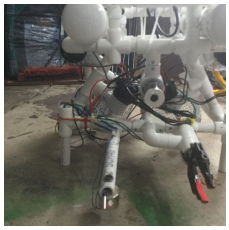
Milton SLS is a first-year company. It is composed of four members. By getting the entire Triggerfish donated our company managed to save a significant part of the cost. We went to the MATE site, and we followed the build instructions step by step to assemble the board. We were able to construct a claw as the interface.

Design Rationalization

For our robot we first had to build it out of PVC pipes. When we finished building the outline, our team began assembling the circuit board. Following the instructions, we soldered the board together. We faced an issue where the motor LEDs would not turn on. Using the voltmeter we identified a short and were able to fix it. Next, we got the monitor and the camera working and attached the motors to the robot. Finally, we drilled all the parts of the robot together to keep it from shifting. We got a lot of ideas from the MATE Fly Thru Video for the event to try to keep things simple in the design process.

Final Completed ROV shown as follows.

Left Side View Front View Right Side View


back view

Drawing Dimension of Rov:

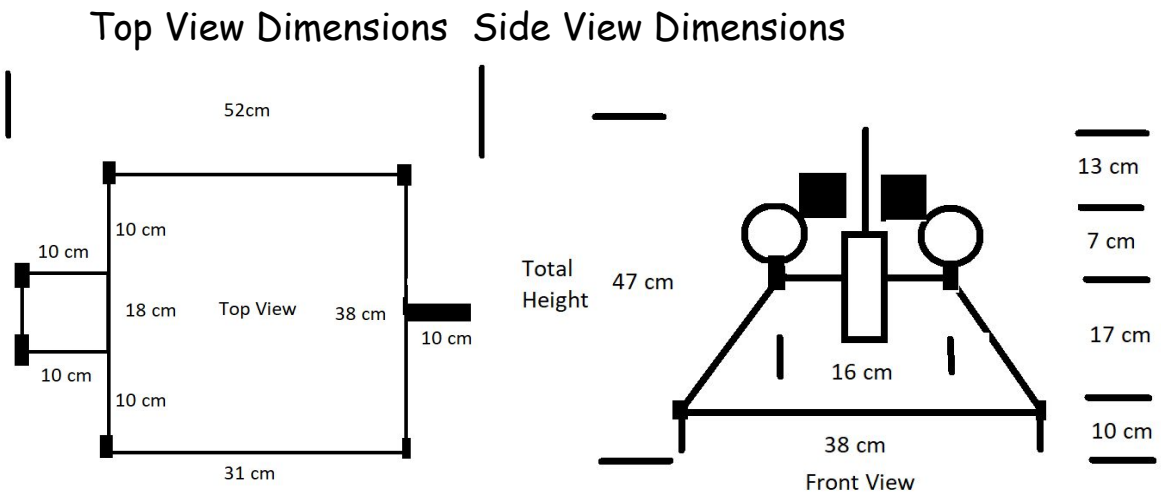
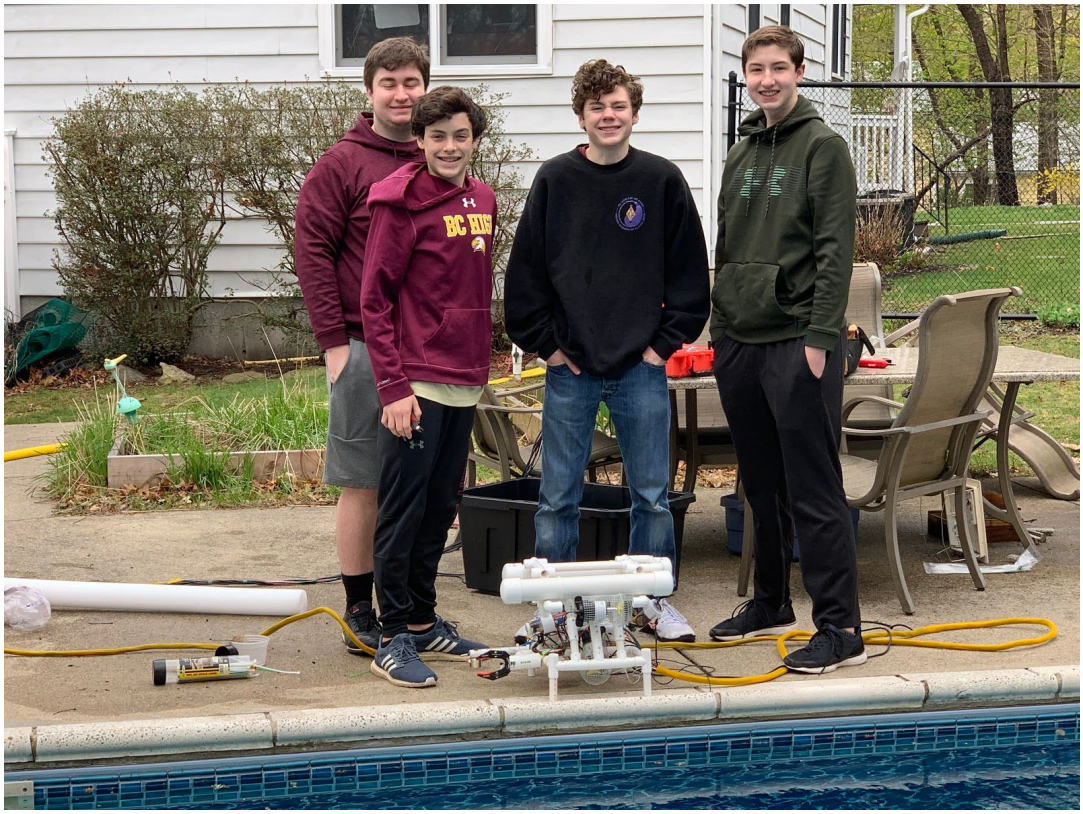
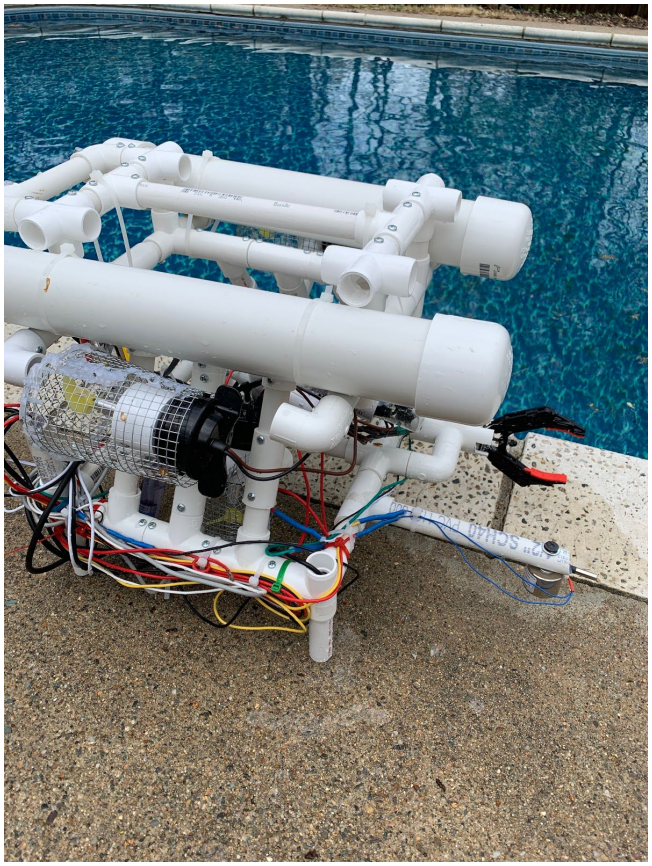


Photo up: Rov frame diagram

Frame:

We decided on a vector design for better maneuverability. We pre-cut PVC into 1, 2, 3, 4, and 6-inch pieces to save time while building the frame. The frame was made with $\frac{1}{2}$ inch PVC pipe, mostly T-Fittings, plus fittings and 90 degree fittings.



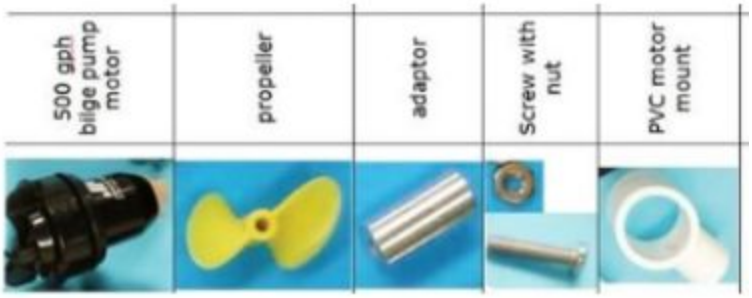


first pool test (up and left)

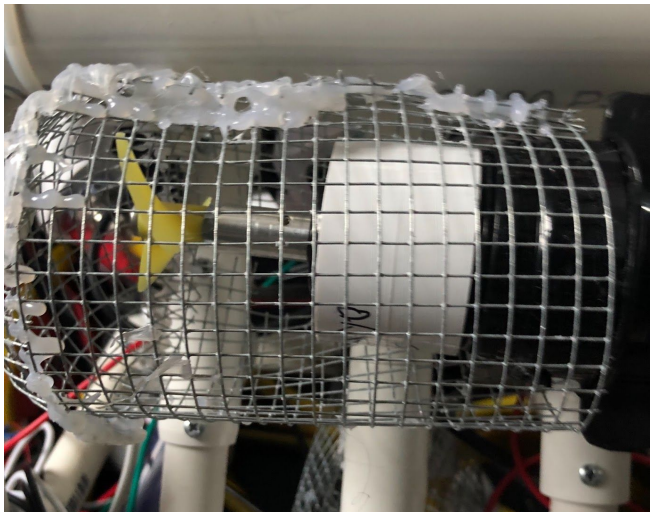
Thrusters:

We have four thrusters in our vector design. Two horizontal and two vertical thrusters located in the center of our ROV. This helps with the center of gravity. We mounted them onto the PVC and used metal mesh to build a shroud over them for protection. We used the bilge pump motors and the propellers supplied in the kit of parts also shown below.

Here is showing the propeller used and the motor used as part of the standard kit of parts.



This shows the protective cover over the propeller and the motor that was made out of chicken wire


left side motor

Manipulation and Lift

For game piece manipulation we are using a claw and electromagnet. Both are controlled in the box by switches. For lift we have two ballast tanks, and a balloon which can be inflated and deflated to match our needs. An airline runs through the tether to a hand pump which can put in and take out air.



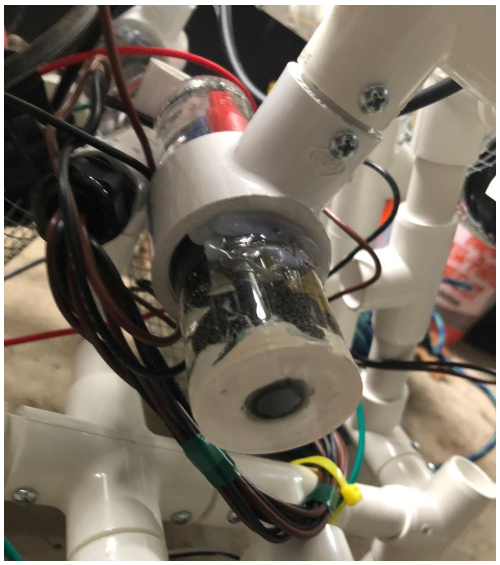

Top left: ballast tanks
Top right: electromagnet
Bottom left: the claw
Bottom right: view of the back of the Rov

Cameras:

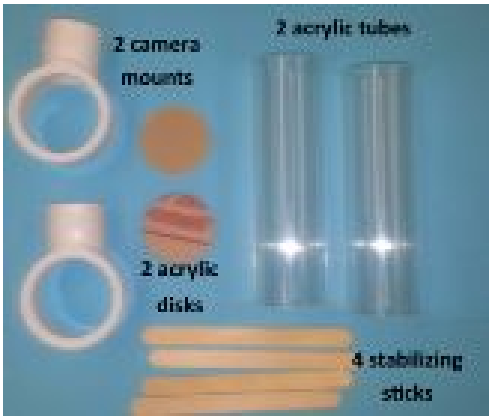
The two wide-angle cameras are the cameras that were acquired at the same time from the MATE store with the Triggerfish kit. The cameras

were potted with epoxy to seal them from the water. One camera is in the front facing the claw and magnet, and one is in the back facing the metal detector.

Rear Camera Mount



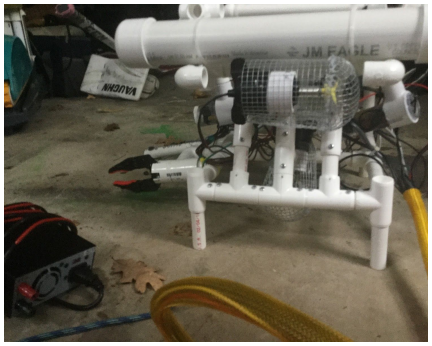
Water-Proofing Kit



Ballast:

From Home Depot we used 2 inch PVC Pipe 12 inches on each side with caps on the ends, and were lucky enough that this was the perfect amount of lift needed.

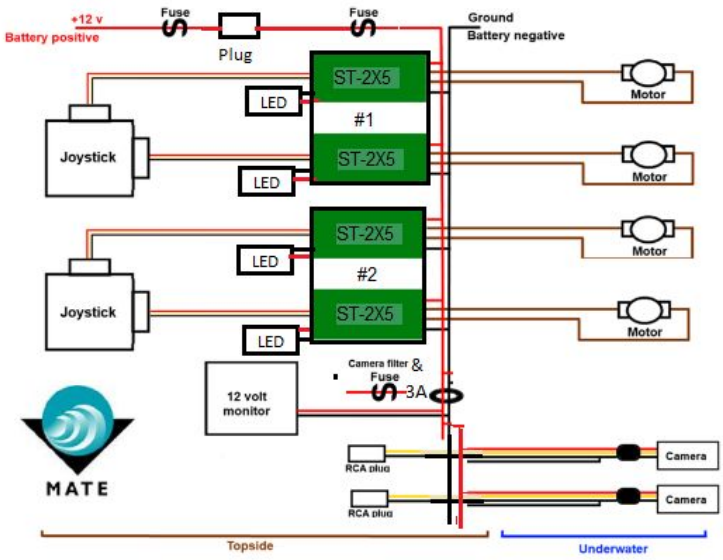
ballast 



right side

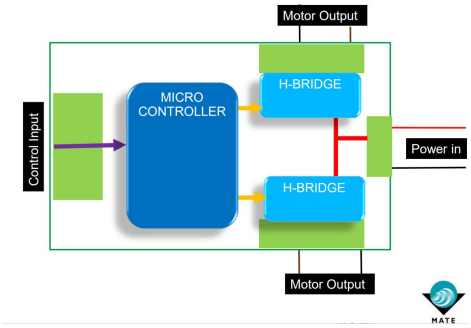
Control System:

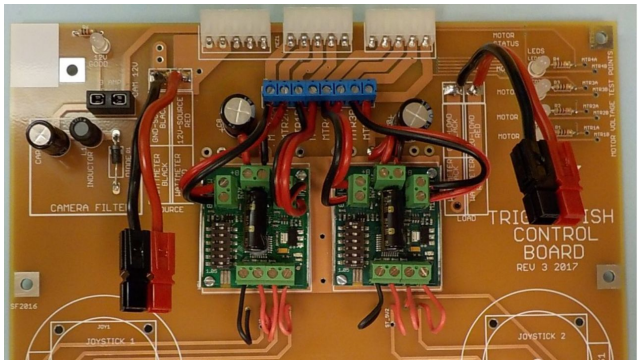
The controller that comes with the kit is what we used right out of the box. It uses two Sabertooth Motor Controllers, two joysticks, a power meter, and 2 switches that operate the claw, magnet and metal detector



Sabertooth control box

Sabertooth Overview





Sabertooth Controller is shown above on how one controller powers two motors and what they look like mounted on to the board on the left.

Safety:

All of the wires and electrical connections are soldered, sealed in hot glue and shrink wrapped. The cameras are sealed in epoxy and tie wrapped securely onto the ROV. To make sure that the PVC on the robot sure we screwed them in at every connection. We also placed guards over the motors to prevent an injury from getting to close.

We found that wearing our safety glasses in the lab was a big safety concern. Many times we would forget them on top of our heads. But, while soldering, we were always cautious to put them on so nothing would get into our eyes. We also needed to use safety glasses while snipping.

Safety Procedures:

1) Always wear your safety glasses when working on the equipment and in the lab.
2) Make sure when soldering not to get burned and use the proper soldering iron procedures.
3) Use caution when using power tools and equipment.
4) Always clean up after yourself in the lab. Wash hands with cold water if you were soldering
5) Electrical Wiring should be neat and of workshipman like quality.
6) Always make sure your ROV is plugged into the GFI outlet before plugging it in or putting the ROV into the pool.
7) Always check your wiring on your ROV for loose or exposed wires.
8) Covers should always be over the propellers.
9) Physical Inspection to see if things are going to fall off of the ROV.
10) Looks for Sharp or Hazardous objects that could cause injury.

11)Make sure the tether is secure on both ends of the control box and the ROV.

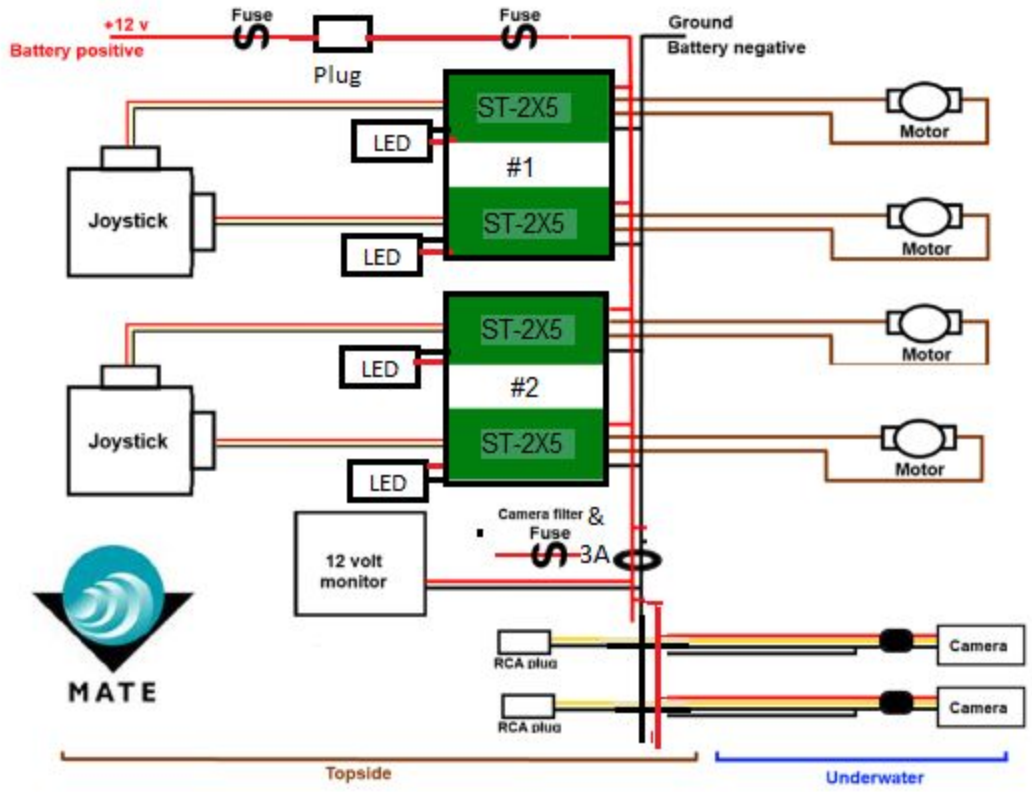
SID: System Interconnect Diagram

We used the Triggerfish kit with 2 Cameras and Sabertooth Motor Controllers without modifying them. We added a temperaturer reader and 2 magnets. We may use hand pumps to inflate our lift bags and to increase or decrease the buoyancy of our ROV incase of emergency.

SID System Controls Diagram

Modifying the Diagram provided in the class material. Two potentiometers are connected to each joystick. Each joystick controls one Sabertooth 2X5 motor speed controllers (#1 and #2). Each ST-2X5 motor speed controller operates two motors. Controllers work with nominal 12-volt batteries and power supplies.

Fuse Size Calculation = ROV Full Load Current *150% = 15A
= 10A *150% = 15A



Saber tooth controller diagram

We May or may not incorporate this into the design
SID Airline #1

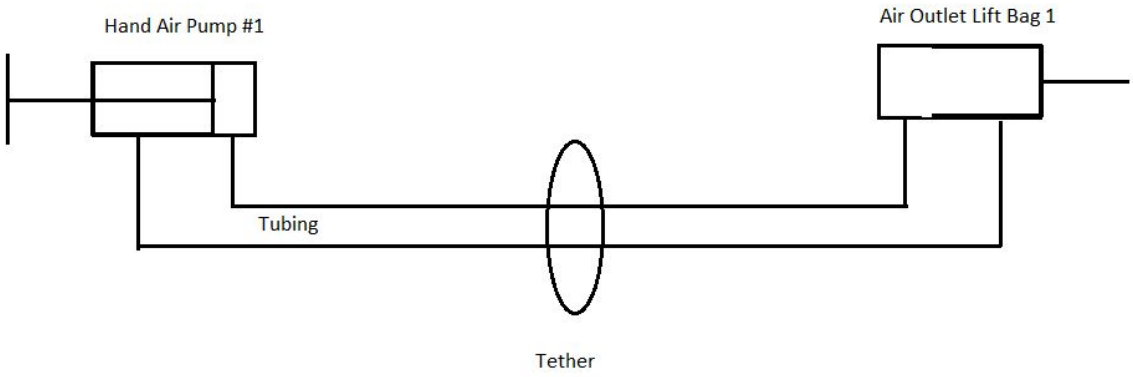


Diagram of air ballon idea

Materials:

Some of the materials used are from the Triggerfish standard kits of parts. Plus some magnets, hose, cables and a claw and cameras

PVC Pipe and Fittings
Tie Wraps
PVC Glue
$\frac{3}{8}$ Self Tapping Screws
Triggerfish Standard kit of parts
2 Wide Angle Camera and Waterproofing Kit
Tethre 8 Conductor Cable
Fish Tank Air hose 50 ft
Electromagnet- One 5 lbs pull strength Magnet
Hot glue, (small)
Makerbot claw

Budget and Cost Accounting:

Budget:

Most of the parts were paid for by our parents.

Cost Accounting:

Costs:

Triggerfish Kit$700
2 Cameras $180
Hydraulic Kit $ 20
PVC ½ Pipe $ 15
Fish Tank Air Line 100ft $ 20
Mate Required Tools $250
Ender 3 $200
Tie wraps $20
Power Supply $160
PVC Fittings $ 41
Chicken Wire $15

Total $1571

Donated Goods $0

Grand Total Cost $1571

Project Management and Teamwork:

We started the project in the middle of March and worked on it most weekends. Estimated 120+ hours total between 4 of us. We were crunched for time. However we were able to self specialize and work on different jobs independently which allowed us to complete multiple parts of the robot at once. We learned a ton through trial and error.

Critical Analysis

Challenges:

Late Start we did not get started until the middle of March, and we did not think it would take as long as it did to complete.

We are a First Year team and had to learn everything from following the MATE installation directions on their website. We followed the build instructions for everything that we did. It took a lot of time to go through all of the information.

We had some short circuiting in the box and had to troubleshoot, which took a lot of time.

It took all of our remaining build time to get the ROV functioning, and we had Little Practice Time on the game parts of the challenge.

Lessons Learned:

The internet is a treasure trove of information

We need to schedule our time around what can go wrong not what can go right

We can invest in making the game pieces, so we have the stuff to practice with before the event.

Testing:

In order to test the vehicle our company designed a series of challenges based off of the 2018 Maye Season. We then used one of our members pool to test the ROV's ability to work underwater and to familiarize ourselves with any potential obstacles. After testing the ROV we used our constructed obstacles to plan out our strategy for the competition, optimizing speed and efficiency in order to maximize points.

Sponsors:

Jimmy Suppelsa- Onsite Coach
Tony Suppelsa - Motorola Solution Foundation Volunteer

References:

M.A.T.E. - While building the robot we referenced the official MateROV website for guidance. Without this documentation, we would not have been able to complete the project. We found the documentation to be well put together and informative.

"Https://Www.marinetech.org."
MATECenter. "2019 RANGER Class Fly-Through." YouTube, YouTube, 20 Feb. 2019,

MATECenter. "MATE 2019 RANGER Competition Class Props Demonstration." YouTube,

MATECenter. "MATE 2019 SCOUT Class Mission Demonstration." YouTube

MATETech. "RANGER Demonstration Prop Building Instructions." 14 Mar. 2018.

"TriggerFish REV 3 Control Box." Google Slides, Google, docs.google.com/presentation/d/1IlkVZEefd1n1wXWCNFedG22FnOCXc_ajK1-3W2I5Vkc/pub?start=false&loop=false&delayms=3000&slide=id.p.

"SeaMATE PufferFish Video System Kit (1 Camera)." SeaMATE, seamate.org/collections/add-ons/products/seamate-pufferfish-video-system-kit-1-camera.

Company Name: Milton SLS

RANGER CLASS

BC High & Milton High
Boston MA, 02186

Team Members:	**Grade, School**	**Role**
Finn Suppelsa	Grade 9th, BC High School	CEO
Henry Synnott	Grade 9th, BC High School	CTO, Box Technician/Pilot
Philip Synnott	Grade 11th, BC High School	COO/Tether Technician
Ian Lundeen	Grade 9th, Milton High School	CMO/CCO

Team Mentors

Jimmy Suppelsa	Mentor

: