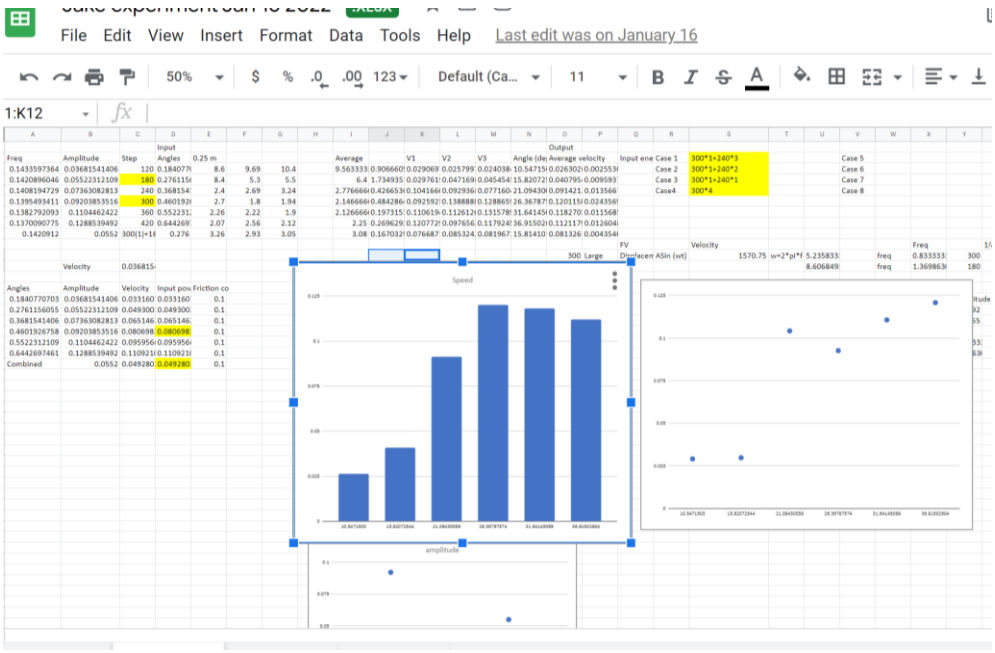
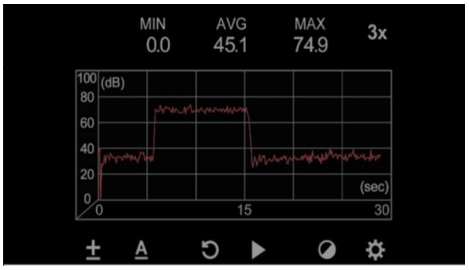
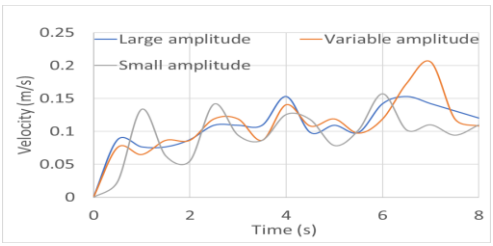
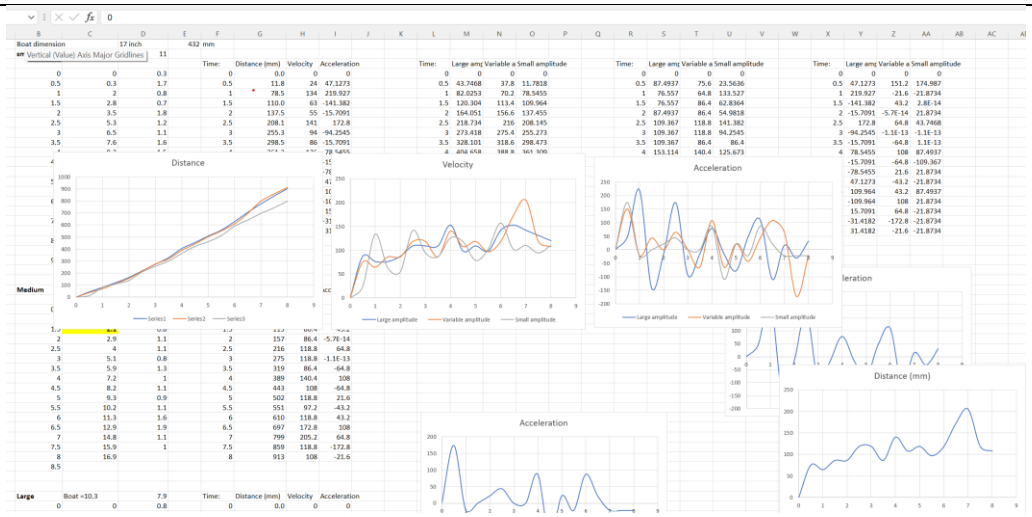
STEM RESEARCH LOG

Date	Jan 23, 2022
Activity	Data Analysis using Excel sheet    Using the data from the University of Washington experiments, the data was processed in excel to find the most ideal combination of speed and power coming from the different actuation patterns.
Note:	It was questioned what the power efficiency of the biomimetic black marline boat would be. To measure the input power, the voltage and the current used to propel the biomimetic black marlin boat were measured. With the boat's motor turned off, the idling power was measured to be 2.435 watts. When the step motor was turned on, the current was increased, which resulted in 2.562 watts of power. The input power was the difference of 0.127 watts of power. To measure the output power, the force required to tug the boat across the water was measured by using a spring scale at the velocity of 0.12 m/s. The force was 0.883 newtons. By multiplying the force by the velocity, the output power was 0.106 watts. Therefore, the power efficiency was calculated to be 83%. The power efficiency was surprisingly high in comparison to combustion-based commercial boat systems, which ranged 20~40%.

Date	Jan 16, 2022 12:00 PM
Activity	Experiment @UW   Using the UW fountain as a experimental environment, chosen because of its calm waters and the adequate amount of space for the experiment. The biomimetic fish were tested with different propulsion patterns and data was recorded based on sound, distance, and speed.
Note:	Data will be analyzed.

Date	Jan 15, 2022 2:30 PM
Activity	While trying to process data from Lake Sammamish, it is concluded that the results are too skewed to obtain an accurate result. As a result, research is done around our area to see a suitable water source that is ideal for experimental conditions.
Note:	Broken tail connection parts. Will be fixed and test again.

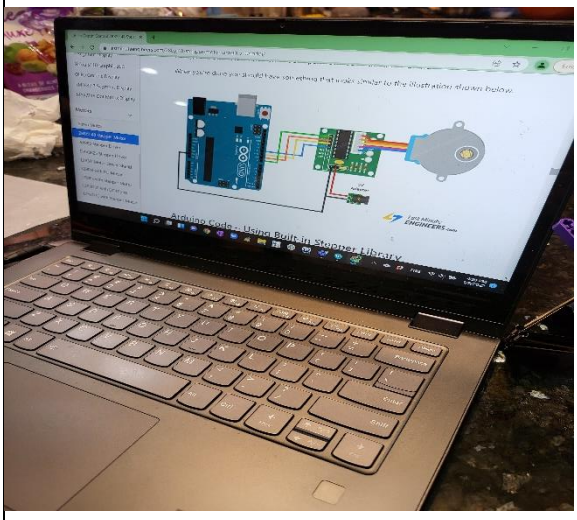
STEM RESEARCH LOG

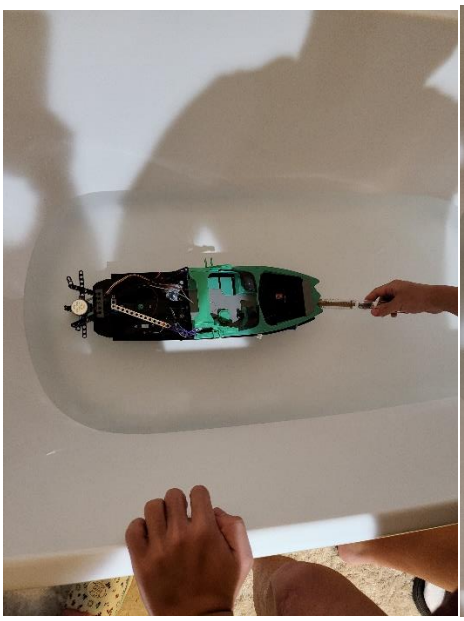
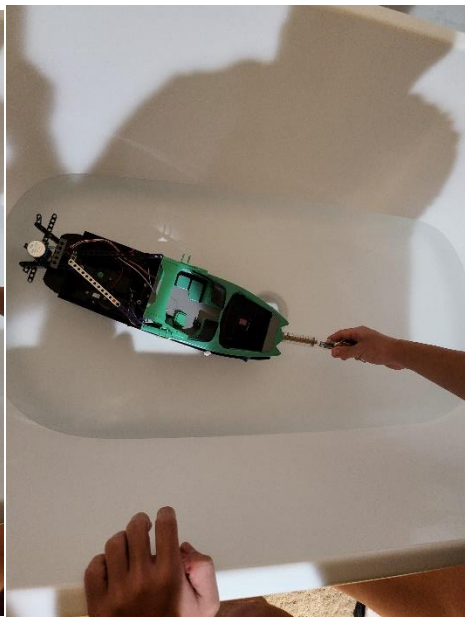
Date	Jan 15, 2022 1:30 PM
Activity	Experiment @Lake Sammamish Experiment was done at Lake Sammamish with newly configured boat and biomimetic fish. The experiments were difficult to conduct and were inconclusive because of the unideal environment of shallow water, and the waves being quite strong.  
Note:	

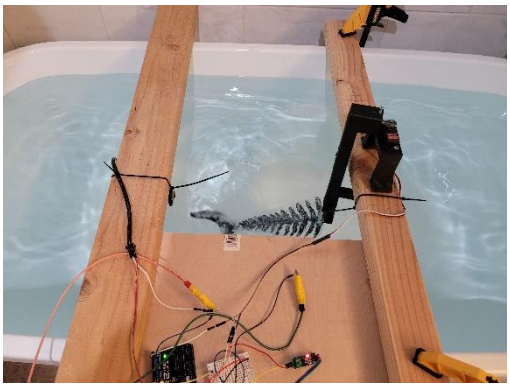
Jake Chung

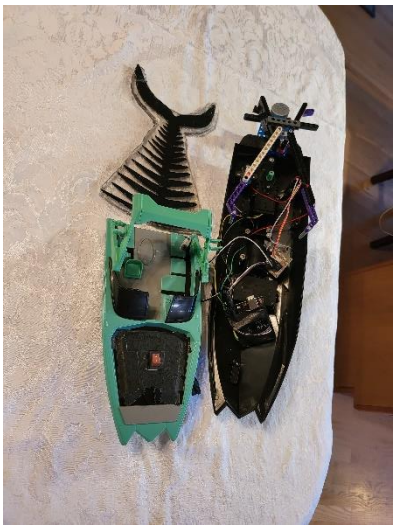
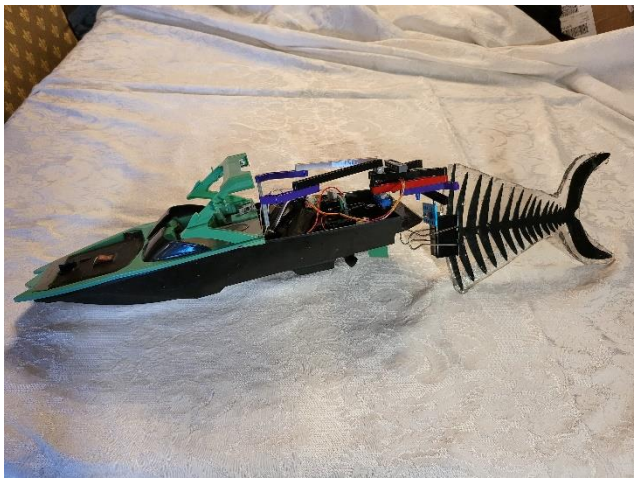
Date	Jan 14, 2022
Activity	To actuate the step motor, programs are made to represent the large actuations, smaller actuations, and then the patterned actuations. The size of the actuations were determined from the earlier experiments to see which would bring the most amount of power.
Note:	Arduino software programing and test

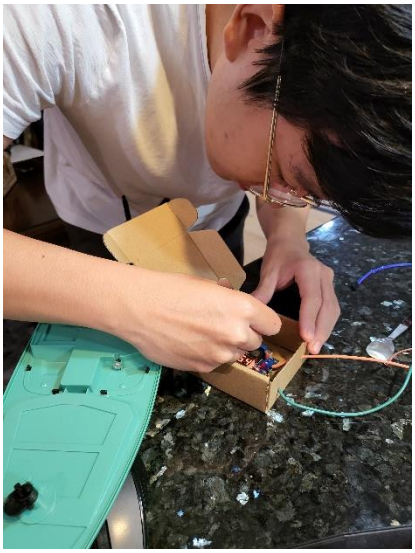
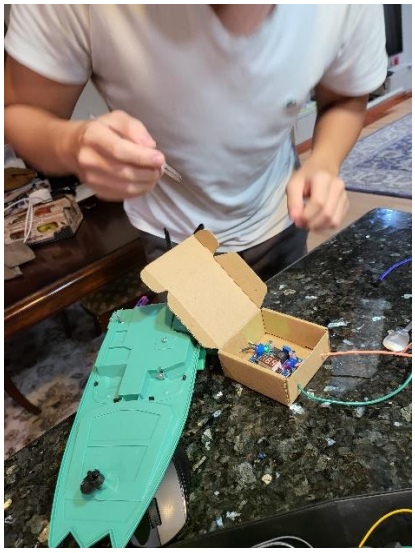
Date	Jan 13, 2022
Activity	To test and see which amounts of actuation would be best, experiments are done. The experiments test to see which length of actuation brings the most amount of power, and then those actuations are selected for later experiments.

Date	Dec 31, 2021
Activity	 To actuate the biomimetic fish with right amount of propulsion a step motor is procured and used to actuate the fish. This is the motor that will be used for infield testing.

Date	Nov 28, 2021
Activity	To measure the water flow rate, an Arduino water flow sensor was bought to test the amount of water propulsion coming from experiments. Studies conducted show the best amounts of actuation required to maximize power.  

Date	Nov 27, 2021
Activity	A bathtub experimental setup is built, with main goal to be tracking the amount of power that comes from the fish tail. An expensive servo motor was bought with the help of the JSHS momentum grant, allowing for better equipment and materials while conducting experiments.  

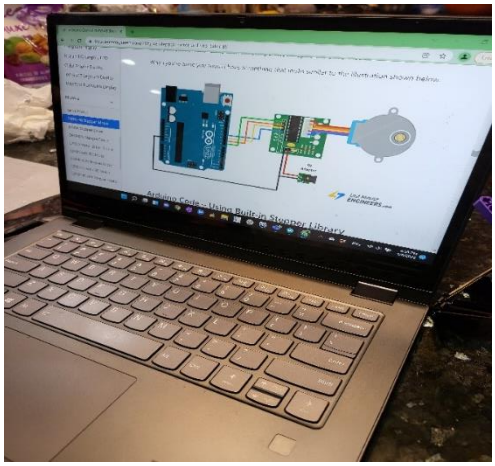
Date	Nov 27, 2021
Activity	Fabrication completed for experiments.  
Note:	To create the boat with the black marlin actuator, a toy boat was first bought from a retail store. The boast was then taken apart with the help of a drill to loosen screws. The top of the boat was taken off, and inside, an Arduino Uno and battery were put into the insides of the boat. The Arduino Uno was uploaded with a program that detailed a pattern of movement similar to the black marlin. Outside of the boat on the back, superglue and screws were used to attach an servo motor that would serve to actuate the biomimetic fish. The original propellor system used with the toy boat was kept, as a way to safely bring the boat back in case something went wrong with actuating Arduino system.

Date	Nov 25, 2021
Activity	To prepare for experiments, an old remote controlled boat is modified to carry a motor that can actuate the biomimetic fish. A battery and sperate actuating mechanism is installed to produce a boat that is propelled by the biomimetic fish.  
Note:	For the experiment, two kinds of biomimetic fish bones were fabricated. One was a general bone structure. The other was a black marlin's bone . Two designs were tested in the experiment. The design was conducted by using Solidworks. The 3D-printed bone was infiltrated with polydimethylsiloxane (PDMS). For silicone infiltration, a PDMS prepolymer and curing agent were mixed at the weight ratio of 1:10, and then poured into a rectangular mold. Subsequently, the excessive PDMS mixture was scraped, removed, and then cured at room temperature for three days. The fabricated black marlin's bone was integrated into a boat for testing. Both biomimetic fish bodies were installed into a plastic boat to study the propulsion efficiency for variable amplitudes. To actuate a biomimetic fish, a step motor was controlled by ATmega 328 microprocessor. The boat velocity was measured using the recorded video clips. The boats' velocities were compared to analyze the effect of a variable amplitude stroke.

Date	Oct 30 and 31, 2021
Activity	The black marlin skeleton is coated with the silicone to create the fish body. The silicone is high quality, and used to create a density of a fish body similar to that of a real one, although artificial it is similar.  

Date	Oct 16, 2021
Activity	The black marlin skeleton is printed with the help of an Ender 3d printer. To bring variation, the thickness of the skeleton is differed to find an ideal size of structure for the black marline biomimetic fish. Bought silicone online to create the body.
Note:	

Date	Oct 2021
Activity	Started the 3d modeling copy of the bone structure of the black marlin. Using images of the skeleton of a black marlin, the structure was roughly copied in solidworks to create a 3d representation of the bone structure of the black marlin.
Note:	

Date	September – October 2021
Activity	Research on different fish that could be copied to make an ideal body. Unique ways of movement in water, such as cuttle fish or squid were considered, but the black marlin was decided on, as it had the highest top speed. The movement of the fish was observed to be one big actuation of its tail followed by 3 smaller actuations. 
Note:	

Date	September 2021
Activity	Brainstorming of new project idea. Reviewed last year's project with the goal of improving the power of the biomimetic fish propelled boat. While thinking of different designs, the idea to copy the body structure of a physically imposing marine animals with impressive abilities to move in the water.