Introduction:

During summer 2016, student researchers Amy Kobylarz, and Sean Westley worked as a team at the Office for Sustainability (OfS), to construct a new aquaponics system which was designed last semester. Aquaponics is a sustainable agriculture method that integrates aquaculture (fish farming) and hydroponics (soilless plant cultivation) into a single, recirculating system. The system upgrade was designed to be durable, low-maintenance, highly efficient with low energy/resource usage, and adaptable with simple troubleshooting and parts replacement; to generate a minimum produce output of 2 lbs per week; and to demonstrate the potential for outdoor and commercial aquaponics in Michigan.

Process/Procedure:

To begin the construction of our newly designed aquaponics systems, we started taking inventory. With this, we were able to assess the quantity and condition of the parts that we had and determine the parts that were still needed.

After receiving all of the parts needed, researchers began working on the plumbing throughout the system. To do this, help was needed from Josh. The piping and fittings were laid out so researchers could visualize what parts went where and so that they could see how each part would be connected to close the system. Plumbing was assembled over a few weeks.

The plumbing involved in our drip towers was something that the team had never used before. Polyethylene tubing was selected after research so that it could be easily sent around corners and continue the proper flow rate throughout each tower. Two different sizes of tubing were used, ½ inch for the main water supply to the towers, and 1/8 inch to actually drip water from the main tube to each individual tower. The plumbing for the vertical grow towers has an entirely different pump that was selected to provide water to the towers that are about 20 feet higher than the pump and at the proper flow rate.

The two filtration methods chosen for our system include a biofilter and a radial flow separator. These two components needed some major work before we could incorporate them into the system. The radial flow separator stand that was previously designed was not strong enough to hold the system at the correct position with the weight of the water that it would contain. Researchers had to redesign the stand and build it. The
structure chosen and built was a honeycomb stand to eliminate pressure from building up at any particular place. The biofilters stand also needed to be adjusted. The height of the stand was incorrect, so an additional 4 inches were added to the base to give it the appropriate height needed for the performance of the system. In addition to this, the filter includes a drain to help clean the system at the very bottom. This feature caused a lot of leakage and forced researchers to repair the pipes and fittings to make it completely free of leaks and perform properly.

The fish selection was reevaluated and Koi were selected as the fish for the system. This species was chosen because less heat energy is required for them, they do not have strict dietary needs, and they will produce an ideal amount of waste to fertilize our plants. There is a great aesthetic appeal with this species and they will live a very long time. Rather than harvesting these fish for food, they can be sold to the pet industry for about $25 each after about 8 months when they reach 8 inches or $130 after about 12 months when they reach 12 inches.

Figure 1. (left) Shows the student researchers plumbing plan and design. (Right) Shows students design idea for the biofilter

Figure 2. (left) Shows students plumbing layout before construction (right) Shows students grow towers and deep water culture beds with plants starting to grow.
Commentary/Reflection:

During the construction process, researchers ran into far more problems than expected. After trial and error, components of the system including the fish tank viewing window and the biofilter continued to leak. Researchers tried to add new products and sealants to the existing pieces to fix the leaks, but eventually had to take the entire piece apart and reconstruct it. This problem lengthened the completion of the build greatly because the team was set back by having to run water through the system, emptying the water, adding new products and giving them adequate time to dry each time the water leaked. This process was a bit discouraging.

In addition to the leakage, researchers had to order specific parts needed for the system. Different components of the system like PVC parts were unavailable in local stores, so researchers spent a lot of time trying to find the right pieces that were needed when they were only available online. This also set the completion of the build back because the team had to wait for the parts to come in.

The previous team had designed the system but did not leave much instruction for the following team. This made it very hard for the current researchers to figure out what the plan was for each component of the system and figure out what their thought process and plan was.

While researchers were actually building the systems components, they were unable to use the equipment needed. With this, they had to find resources outside of the office to make the proper cuts needed for the structures of the stands. Because the availability was limited, the construction was delayed.

Next Steps:

Though the build was frustrating and lengthy, researchers are excited to test their new system. This is the first system to use koi fish and vertical grow towers. The team plans to investigate whether the vertical grow towers are beneficial to a system of the Office for Sustainability’s size and if it is more profitable to sell the fish output into pet trade rather than as a food supply. There is not much research found on using Koi in an aquaponics system, but Koi ponds are very popular. The team plans to collect and record data using this species and hope to use the collected data to publish a paper.