Panther Power Team 1159, a F.I.R.S.T Robotics Challenge Team

The Academy of Our Lady of Peace, New Providence, NJ

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We are Panther Power Team 1159, a F.I.R.S.T Robotics Challenge team. Through the *FIRST* LEGO League (FLL), teams are introduced to STEM through exciting and fun hands-on learning. Each year, *FIRST* challenges teams to solve a real-world problem through worldwide robotics competitions. We are the team from The Academy of Our Lady of Peace, located in New Providence, New Jersey. Our team is made up of eight students from grades 4 to 8. Each competition consists of a Robot Challenge, Innovative Project, and Core Values/Teamwork Challenge. We looked at many problems but chose the problem of algae and hydro-electric power plants.

Our team was tasked to find a problem about an energy source and create a solution to improve it. We started learning about hydroelectricity and algae. After doing some research, we voted to make a solution to benefit hydroelectric dams. We chose to clean up the water and remove the algae that clogs dams and other hydroelectric power plants and nuclear power plants. Our solution would also remove toxic bacteria associated with the algae that kill wildlife.

To decide on this project, we used a few strategies. First, we used the process of elimination. We looked at many problems then decided which one we were most interested in. We did further research and we talked to experts. Then we discussed and shared what we each discovered so that everyone's opinions could be expressed. Then we voted on our final project

We used all the steps of the engineering process to help define the problem and design a solution. Defining the problem wasn't hard as we had set parameters and we did a lot of research to help us specify requirements and choose a solution. After this we developed ideas for our boat to be used for the final prototype

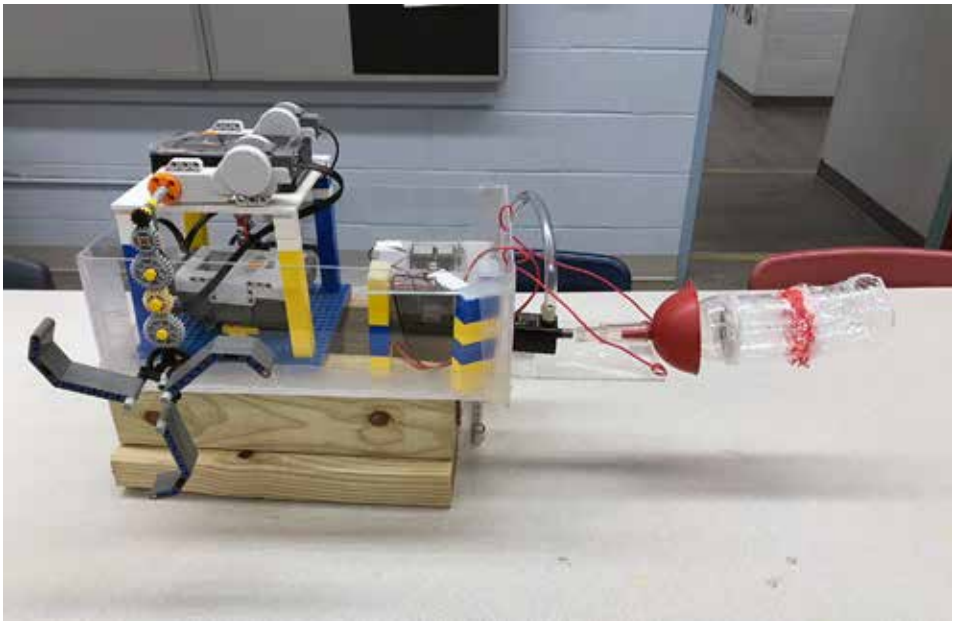
and then we made a working model and tested our solution. We determined that this final prototype met all our requirements, and we communicated our results to our experts, judges at both our regional and state competitions, and our community.

We did experiments to help us understand all the features we might include in our solution. One experiment was with a pump and tubes to suction water from one bucket to another. It taught us about how a pump could suction the water and algae out of the lakes and reservoirs. Also, we tested the mesh and various-sized rocks to see what the best sizes of mesh are to use for our filter. We tested what would be the best material to use for our working prototype. Also, we did an experiment to see if the propellers could work in debris like algae and duckweed.

We talked with some experts, including Dr. Stephen Souza from Clean Waters Consulting LLC, Dr. Jennifer Graham, and Sabrina Perkins from the US Geological Survey (USGS). Dr. Souza is a former President of NALMS (2000-2001) https://www.nalms.org and Dr. Graham is the harmful algal bloom coordinator for the USGS water Mission. They helped us improve our solution by listening and giving us feedback. They suggested that we design removable filters. They also taught us about flocculation. We decided to add alum to our tank of killed toxic microscopic bacteria so that bacteria could be filtered and removed. They also spoke about other methods they are using including nanobubble technology.

Our project is focusing on toxic algae and plant life in reservoirs leading up to hydroelectric dams. Algae and plant life in hydroelectric dams can jam turbines. Cyanobacteria (blue-green algae) is a toxic bacterium that can harm humans and wildlife. This toxic alga can contaminate the water and make it unusable for drinking, irrigation, and recreation. To solve this problem, we designed a rectangular boat with well-researched features to remove the algae and plants.

We have designed a prototype that is a working model made from plexiglass. It uses waterproof tape and caulk to make it watertight. We programmed two Lego propellers to move the boat in a pattern on the reservoir behind the dam to clear the water of debris. Everything in the boat is powered by rechargeable solar batteries. The front of the boat has a working pump that draws water from the reservoir into a series of filters. The filters use different-sized meshes to catch large to small-sized algae and plants. The filter unit is removable, replaceable, and can be cleaned. We can then compost any non-harmful algae and plants from the filters. Microscopic toxic algae, which is not caught on the filters, goes through tubing, and passes an Ultraviolet-C lamp which kills the cyanotoxin and cyanobacteria. The UV lamp is controlled by a switch. These materials are collected and flocculated in a tank using alum and a device to stir the alum with the other materials. The water is filtered through a fine mesh and the cleaned water is then returned to the reservoir.



Our innovative project, the Hydro-Electric Toxic Algae Cleaner, or H-TAC for short, could help the problem of toxic algae blooms and other plant life that can harm hydroelectric power plants.

We learned that current methods to prevent harmful algae and plants in water include the addition of peroxides, probiotics, and algaecides directly to the water. Each of these methods could harm wildlife. The use of sonication and nanobubbles have shown some limited effect, some studies show that they may not be able to kill all toxic algae bacteria. There are several advantages to our design. Our design does not put chemicals into the body of water. The filters do not harm fish or other animals. Non-harmful algae and plants can be composted. Many studies have shown that Ultraviolet-C lamps can effectively kill bacteria. Through flocculation and fine mesh filtration, killed toxic bacteria can be removed from the water. The vehicle is unmanned and can be programmed to efficiently clean the algae from many types of waterways. In addition to hydropower plants, harmful algae blooms can affect many types of waterways. Our innovative solution could also be used to treat other waterways including lakes and ponds that have harmful algae blooms.

In conclusion, we worked hard and learned new things about hydroelectric power and how it has problems that need solving. Our innovative project, the Hydro-Electric Toxic Algae Cleaner, or H-TAC for short, could help the problem of toxic algae blooms and other plant life that can harm hydroelectric power plants. This is important since some countries like Sweden and Norway rely on hydroelectric power as a major source of energy.