

## **Proposal for Aquaneering zebrafish e-rack**

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Port Washington High School (PWHS) is a comprehensive high school located in Southeastern Wisconsin with about 900 students. Our proximity to metropolitan Milwaukee provides many opportunities for our students interested in STEM to work with community partners in industry, business, health care, and education. Notably, through collaborative efforts with Milwaukee School of Engineering (MSOE) and more recently Concordia University Wisconsin (CUW), we are continually advancing STEM education in our school. With the additional proximity to Lake Michigan, we have a unique opportunity and responsibility to inspire our students to understand freshwater science and become active in the responsible stewardship of our valuable nearby environmental resources.

In support of our growing STEM curriculum, the Port Washington – Saukville school district recently passed a referendum to remodel the school. The work underway includes significant supportive changes in our infrastructure that includes expanding the Science classrooms and lab spaces. A grant received also provides some support for an aquaculture lab on the science floor for primary use in fish culture research and aquaponics within the science department. We are actively seeking further grants and contributions to supplement the basic building infrastructure including equipment. Although our students and staff are new to fish culture and zebrafish, our resources and goals are strongly aligned with the intent of the aquaneering e-rack award program and supportive programs in the zebrafish community. In this environment we are certain that the award of an e-rack would be an integral part of our ongoing efforts to provide students with authentic learning in STEM.

Community connections are key to growing our science initiatives at PWHS. For example, the recently opened "Exploreum" is an interactive information center/museum about Lake Michigan and its connection to our community and located just blocks from the school. Both "Riveredge" and "Schlitz Audobon" nature centers have offered day classes recently that provide a nice connection to inland water systems and Lake Michigan. This last year we have made connections with Concordia University of Wisconsin (CUW) to partner in both environmental science and the health care field. These connections have led PWHS to offer Advanced Placement Environmental Science starting in 2017.

For Biomedical Sciences, PWHS sponsors a PLTW program in partnership with MSOE. Toward this program we have implemented three courses: Principal of Biomedical Sciences, Human Body Systems, and Medical Interventions. These courses provide problem solving

based medical learning that additionally allows students to earn MSOE college credit. In the biomedical program, we currently have nearly 100 students taking four different classes offered. The courses are designed to be taken consecutively, the first course introduces freshmen to general lab procedures and students begin to develop their research skills needed throughout future courses. Students begin research on the heart and medical interventions needed, diabetes, sickle cell anemia, and a general emphasis on genetics. Throughout this course there are ample opportunities for students to incorporate content from the biomedical course and use it to study and learn from the zebrafish. As those students progress through the program, they are introduced to more and more topics which become apparent in the third course: Medical Interventions. It is in this class that our partnership and use of the zebrafish will be instrumental in exposing students to zebrafish disease models and the many research opportunities available to them, as students run open ended experiments using the following topics that translate well with zebrafish. The topics included are introduction of p-GLO plasmid into bacteria, protein/DNA electrophoresis, and ELISA assay. Through CUW and the guidance of Michael Pickart (faculty member of CUW School of Pharmacy), our goal is to integrate relevant zebrafish disease model activities in support of this curriculum. As an example, mutant zebrafish strains carried at CUW will be useful for students to understand and explore concepts in signal transduction that impacts zebrafish pigment and utilize techniques learned in this course. Toward this end, we have had multiple organizational and brainstorming collaborative meetings with Dr. Pickart over the last 6 months and plan to continue these discussions (approximately quarterly) to further conceptualize and implement our collaborative efforts.

The 2017 school year will be our first to offer the 4<sup>th</sup> and capstone course for our PLTW curriculum. Initially, we envision this to be the most immediate area of impact for an awarded e-rack zebrafish system. A multi-tank system would be essential to house varied zebrafish strains useful to support our students' investigational efforts. The students will be exposed to many different topics during the capstone course including community epidemiology, environmental hazards and their impact at the genetic level, work with DNA electrophoresis to analyze water samples. Students will be expected to present their findings in a formal poster presentation in addition to a written paper. Our plans in fish culture overlap nicely with the capstone course as well using the zebrafish for investigating the environmental factors affecting breeding and survival of fish species in water systems. Such factors will include, but not be limited to turbidity, chemicals found in runoff (Nitrates, phosphates, etc.), light, heat, etc. A multi-tank system would be ideal for this kind of comparative study, as it would serve to control and standardize the variables. This directly connects to the Next Generation Science Standards in the following ways:

Students will evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. (NGSS HS-LS2-6)

Students will evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. (NGSS HS-LS2-8)

Under Dr. Pickart's guidance, we plan a part of this work to include assessment of environmental hazard toxicity through implementation of a zebrafish limit test to evaluate

survival (and sublethal effects). As an internationally accepted standard approach (Office of Economic Cooperation and Development, OECD 203, Annex 2) our students will have a tool to accurately assess environmental toxicity that can be presented in professional forums, e.g. appropriate journals and conferences. Ethically OECD 203, Annex 2 "...represents both best practice and an ethical benchmark for *in vivo* testing for acute fish toxicity" through the use of a "threshold" determined from invertebrate species' EC50 values.

Additionally, we hope to develop other methods to determine the health impact of environmental toxins with Dr. Pickart by directly assessing the impact of environmental samples/toxins on signal transduction pathways controlling zebrafish pigment. CUW will house relevant strains of zebrafish for such testing as well as appropriate wild-type strains of zebrafish and provide these fish for use in our aquaculture lab during the school year.

To ensure students are trained appropriately in zebrafish husbandry and have access to advanced zebrafish research tools, we will integrate our zebrafish efforts with Dr. Pickart's laboratory staff and students as well as becoming active in the Zebrafish Ambassadors Program of the Zebrafish Disease Models Society. Mr. Callies and Mr. O'Brien have already had an introduction to the monitoring, care and equipment for zebrafish through CUW. For our students, we plan to develop a mentorship program for PWS students in Dr. Pickart's lab. This may take the form of a summer internship or as integrated curriculum during the school year. During the current school year, we explored this conceptually with a PWS senior student who worked as part of a high school after school team in the CUW zebrafish labs. Over the course of this year, we will meet to formalize this program for both basic training and in support of the PLTW Biomedical Science capstone course.

In this rich environment that we are creating, we anticipate research done by our students and staff. This will give us the opportunity to engage with the zebrafish and larger science community. Our planned participation in the Zebrafish Ambassadors program is one such way we will participate and hope to do so at an upcoming conference in 2017 where we can nominally describe our progress in building our infrastructure and curriculum to involved active zebrafish research. As opportunities arise, we will present our work (formally supported by the Biomedical Sciences Capstone Course) as written articles and those that would be novel and noteworthy will be submitted to scholarly periodicals. This would provide students with an opportunity to develop science writing and establishing legitimized research background. Some journals that would be possible sources would be "Zebrafish" and "Environmental Research".

The eRack would be a big step forward in establishing many ties to science curriculum. As stated previously, the eRack's use in the PLTW courses and AP Environmental Science would be essential because of those courses having set research requirements. However, our school would have other uses for it in AP Biology, AP Chemistry and AP Physics. By having new directions, our school is developing and well-established courses finding ways of implementing instruction with an eRack, it is safe to say that we have many needs that can be satisfied by this system. By getting students to take ownership in the care and maintenance of the aquaculture lab, we believe we will foster interest in our science courses and zebrafish studies.

PWS, Science Department Goals and Timeline for Aquaculture Laboratory:

| <b>Course/Program</b>                          | <b>Description</b>  | <b>Dates</b>          |
|--|---|-----------------------|
| Youth Service Learning                         | Initiate a student lab internship for the Aquaculture Lab.  | Fall, 2016            |
| Science Dept./CUW                              | Establish a meeting/training with Dr. Pickart's lab group once every quarter.   | Fall, 2016            |
| AP Science and PLTW Courses                    | Identify labs, research and needs for Aquaculture Lab and work out a viable schedule.   | 2016-2017 school year |
| Science Dept.                                  | Move equipment into new Aquaculture Lab.  | Spring 2017           |
| Youth Service Learning/<br>Workforce 2020/ CUW | Establish summer internship with Dr. Pickart's lab at CUW.  | Spring/summer 2017    |
| Science Dept. Reps                             | Attend Zebrafish Ambassadors conference   | Spring/summer 2017    |
| AP Environmental Science                       | Start first year of course, using Aquaculture Lab as research/ lab experience   | 2017-2018 school year |
| AP Environmental Science, PLTW                 | Submit research articles for publication in appropriate journals  | Spring 2018           |
| Area and Conference school districts           | Work to establish an ongoing relationship with other schools to support research projects and demonstrations of Aquaculture Lab | 2018-2019 school year |