



## SAILOR STEM Boatbuilding Program

### Contact Information

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### Location Information

Independence Seaport Museum  
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### Program Information

#### *Program Duration*

- September 21, 2015 to June 18, 2016

#### *The Need for STEM in the Philadelphia Region*

The SAILOR STEM Boatbuilding initiative connects underserved middle and high school students in the Philadelphia area to the water. This program targets young minds to encourage interest and understanding in Engineering, Mathematics, and the Sciences in addition to team-building, problem solving, and leadership.

Given the fact that 100% of the public and charter schools in the city of Philadelphia are rated as Title 1 schools, this puts at least 40% of Philadelphia students at or below the poverty line. Through SAILOR, we are reaching out to this underserved population and providing them with an opportunity to succeed. Girls specifically are a missing part of the STEM workforce. Currently, only 14% of Engineers in the workforce are women, according to a recent study by the Congressional Joint Economic Committee. By having an afterschool program that also attracts and encourages girls, we intend to bridge this gap in our region. In the 2014-2015 school year, the demographics of the SAILOR students we are reaching are as follows: 8% White, 8% Asian, 13% Hispanic, 72% Black, and 63% Female.

The students that participate in SAILOR come from impoverished neighborhoods from all over Philadelphia, PA and Camden, NJ. The majority of our students attend public schools within the School District of Philadelphia, where budget cuts affecting STEAM classes are rampant. ISM's partner school, Bodine High School for International Affairs, a magnet school in the Philadelphia school district, suffered such

harsh budget cuts during the 2014-15 school year, that they were forced to cancel their Physics classes for students. Michael Schieber, a teacher at Bodine said the following, “Schools are the building ground for children’s lives; we should give students the tools to explore new ideas and the confidence that they can achieve anything with a strong work ethic. However, under the current budget constraints that the School District of Philadelphia has endured, we have seen many high level programs, including physics class, disappear from our school’s roster.” In reference to the SAILOR STEM Boatbuilding Program, he added, “The science and mathematics departments at the school are ecstatic by the growing level of interest in their classrooms as more and more of our students are getting experience applying and enriching the theoretical skills they have been working on in the classroom.” Fortunately, the SAILOR program accepts students from any level of understanding in the STEM subjects covered, and teaches those concepts at a level appropriate to each students’ base knowledge. Because we have some classes with students that have a firm grasp of basic math through higher Geometry mixed in with students that have never taken Geometry and don’t even grasp the concept of adding fractions, we are able to utilize our hands-on approach to learning so that each student is able to work through and understand subjects at his or her own pace. There is no grading system for SAILOR because it is an afterschool program, but all of the participating students apply themselves because they are hungry for the knowledge that they haven’t been able to receive in their schools.

The SAILOR STEM Boatbuilding Program is largely teacher-driven. The students that participate are recommended to us by the teachers that work with them every day, and we maintain an open communication with their teachers throughout the school year to make sure we are fulfilling the needs of the school through our program, and that their students are living up to their teachers’ expectations.

Aside from the need for supplemental STEM education for underserved students, there is a nature deficit among the urban community. As part of SAILOR, we have students participate in on-the-water activities including Rowing, Sailing, Ecology, Conservation, and Water Quality activities. Most of the students that come to us are unaware of the Delaware River and its ecology, despite the fact that the river is adjacent to their neighborhoods and schools. When we bring students outside onto our dock for the first time, most of them are extremely intimidated by being so close to a waterway. Most of the underserved students that we teach are ones that have never had the opportunity to leave their cities and visit natural habitats or areas with large bodies of water, so we are required to calm a lot of fears and misconceptions about being so close to the water. Many of our students can’t swim and are absolutely terrified to get into a boat. However, after coaxing them into rowboats and quelling their fears, our students take to life on the water with ease and excitement! It is always incredible watching them later in the school year hop right into a boat and begin rowing like they’ve been doing it their whole lives, knowing that just a few months prior they were terrified of the water.

### *Program Details*

Through our afterschool programming, we build upon the core principals of education and curriculum that students are already learning in their traditional school

settings by taking it a step further. Our students' classroom knowledge is enhanced via an intensive hands-on experiential learning approach to informal education through our SAILOR STEM Boatbuilding Program in ISM's traditional wooden boatshop, The Workshop on the Water. It is through this program that students work together to build a wooden boat from start to finish where the boat is a vehicle for teaching key concepts in Physics, Mathematics, Biology, Engineering, Design, Construction, Technology, English Language Arts, Ecology, and Chemistry, as well as Team-building and Leadership.

Students begin with acquiring a firm understanding of the physics of boats and the Archimedes Principle through interactive and hands-on activities including on-the-water rowing to experience displacement and equilibrium, as well as small-scale experiments and competitions. The students progress to tool safety in the shop by building their own tool boxes using both hand-tools and power tools in order to prepare them for the larger tasks ahead. Upon completion, they move on to the boat's construction which begins with Lofting: The process of taking blue prints of the boat's design and drawing them out full-scale. This process must be extremely precise and is centered heavily on Mathematics including the Pythagorean Theorem and Geometry. Each week, there is a new Foreman assigned from the student groups, so that each student has the opportunity to lead her peers and build skills to become a successful leader.

The SAILOR STEM Boatbuilding Program is based on a hands-on experiential education pedagogy. Our classes consist of 12-14 students per class so that the students can receive the maximum amount of direction and all have the opportunity to experience hands-on STEM. Each class is co-taught by two instructors, one with a background in traditional boatbuilding techniques, and the other with a background in informal science education. This allows for a more cohesive blend between the boatbuilding process and incorporating STEM into the lessons. The program runs from September to June, and the same students attend weekly at their designated day and time. For example, in the 2014-15 school year, Bodine High School has 13 students that participate in SAILOR every Wednesday from 3pm-5pm afterschool. These students therefore receive 33 weeks of instruction in informal STEM education through boatbuilding, and finish the school year with a Launch Party where all of the participating schools in the program come together to celebrate their hard work with a party in the boatshop and by christening their boats on the dock. After the christening and official launch, the students and their families are invited to participate in on-the-water activities, like Rowing, together. This closing event is vital to the program because it serves as an acknowledgement for all of the students' hard work, it brings together all of the students that had been working on the boats in their separate classes so that the students can meet everyone that went into making their boats, and it encourages parent and guardian participation in the program.

The mission of the SAILOR Program is to take traditionally "scary subjects" out of the classroom and put them into a new environment where students feel less intimidated and are able to not only complete new tasks as they are laid out, but comprehend any new subject and retain it. Several of our previous SAILOR graduates

have moved on to become Engineers, and have accredited our program to their interest and success in the subject, and we intend to continue our track record with the next generation of SAILOR students.

### *SAILOR Goals*

The students that participate in SAILOR have a greater understanding of key concepts in Math, Physics, Biology, Ecology, Engineering, Technology, Design, English Language Arts, Chemistry, Team-work, and Leadership because they have been learning-by-doing. Our students don't just learn about Biology, they live it by feeling how the lignin in wood melts to allow an entire steamed plank to bend into place. They don't just learn about Physics, they feel it through the way a boat on the water sinks as their weight displaces the surrounding water or the way it rocks when it isn't balanced. SAILOR students are Engineers, seeing a design in blueprints on paper spring to life before their eyes due to their hard work and dedication. The primary goal of this program is simple, to inspire underserved students to have a life-long appreciation for STEM so that, in turn, they will one day be the Engineers, Scientists, and Mathematicians of the future.

### *Measurement & Evaluation*

We self-evaluate the program during the 2015-16 school year via a Know-Want to Know-Learned (KWL) assessment tool. The students will be asked basic questions to assess their prior knowledge to the subjects covered in SAILOR during the course of the school year. At a mid-way point, we will ask the same questions again to evaluate how the students understand the concepts so far, and then we will ask the exact same questions a final time at the end of the school year for the third portion of the KWL to determine end-result understanding. The final product will be graphed for a visual interpretation of the results.

### *Environmental Connection*

Students begin their school year by rowing on the Delaware River, and after completion of their wooden boats, launch them and end their school year with on-the-water rowing activities on the Delaware River. This instills in them a sense of appreciation and stewardship for their local waterway. It also introduces many of our urban students to a natural world which was right outside their doors, but one which they had never noticed before. We feel that it is crucial to the healthy development of young minds to have a deep connection with nature, whether it is in the middle of a wild forest or in an urban setting. It is through that connection that children grow up to be adults that have a respect and understanding for their global community and are more easily able to find their place in the world.

Each spring in conjunction with Earth Day, SAILOR students get their hands dirty by helping ISM Staff plant our Floating Wetlands Project. This project consists of four floating islands that are planted with native water-loving plants. The Floating Wetlands Project provides intrinsic value to the Delaware River basin by providing visitors with beautiful flora and fauna to observe, thereby drawing attention to the river as a source of life for so many organisms. The Floating Wetlands Project also has the ability to affect positive change; the plants themselves aid in improving water quality by increasing Dissolved Oxygen, decreasing turbidity and improving water clarity by capturing silt, and they provide a home both underwater and above to a variety of fish and invertebrates. In addition to the Ecological changes, the mere fact of the students' involvement encourages them to make a difference right outside their own doors by showing them a project that they can do to help improve their own urban community. Projects like these tend to have a ripple effect, causing students to become more involved elsewhere in their community, affecting positive change for their local and global environments throughout their daily actions.

“Without continuous hands-on experience, it is impossible for children to acquire a deep intuitive understanding of the natural world that is the foundation of sustainable development. ....A critical aspect of the present-day crisis in education is that children are becoming separated from daily experience of the natural world, especially in larger cities.” -Natural Learning, Creating Environments for Rediscovering Nature's Way of Teaching, Robin C. Moore and Herb H. Wong

“Teaching children about the natural world should be treated as one of the most important events in their lives.” – Thomas Berry

In a study by Dr. Will Turner, he and his colleagues find that children playing in urban areas may experience lower levels of biological diversity. Dr. Turner concludes that many people experience biological uniformity in urban neighborhoods, meaning they tend to experience the same species rather than a diverse mix. However, by bringing urban students out to the waterfront and onto the river where they are exposed to the flora and fauna present there, we are introducing them to newer and more varied biodiversity than they would have experienced had they not participated in the SAILOR STEM Boatbuilding Program.

- **Turner, W. R., Nakamura, T., & Dinetti, M. “Global Urbanization and the Separation of Humans from Nature. *Bioscience*, 54(6), 585-590, 2004**

### *Program Cost*

The cost of the program is based on a per student per week rate. This fee is \$20 per student. The cost is determined prior to the program's start and is unchanged based on student sick days or other occasional missed days. It is simply how we determine a flat rate for the school year.

So, for example, if the program runs for 33 weeks with 12 students, the total cost would be \$7,920. If you have any questions about the SAILOR program or pricing info for your group, please contact Jennifer Totoro at [jtotoro@phillyseaport.org](mailto:jtotoro@phillyseaport.org) or 215-413-8621.