

Environmental Science Needs a Student - Powered STEAM Engine

INTRODUCTION

- As a competitive surfer, lifeguard, and certified rescue diver; I have loved the ocean all of my life.
- I want to pursue two career paths: as a professional surfer and as a contributor to ocean environmental science.
- During my preparation for college applications, a great counselor taught me to use a conceptual framework to measure my community service contributions: the problem, the solution, and the impact of that solution.
- While working with a world class scientist who is developing breakthrough innovations that may rescue our ocean, he revealed a surprising problem: college students majoring in environmental science are ill prepared to work on the very challenges they desire to overcome.
- The purpose of this article is to equip students, their parents, and their educators with what they need to know to be prepared to help contribute to the solutions of complex problems in environmental science. I make the case for them to focus on equipping themselves with STEAM Power: The tools of science, technology, engineering, the arts, and mathematics.
- Three experts I have the honor to work with have helped me shape my case: a leading scientist in chemistry who is developing breakthrough innovations in microplastics reclamation from our ocean, a national award-winning middle school educator who has taught me how to teach bystander rescue care through his amazingly gifted methods, and an oceanographer who has the dream job in environmental science many of us would love to have.
- Finally, I share my own mid-course correction in my academic trajectory. These great experts have shaped my choice of courses now that I am a senior in high school. I am taking five Advanced Placement Courses this year in order to optimize my own value to help rescue both people enjoying our coastlines and the ocean I love.

THE EXPERTS

DAVID BESHK

My Dad and I partnered with leading doctors and law enforcement executives to co-found the *Med Tac Bystander Rescue Program* in 2015 that tackles the 8 leading causes of preventable death. It fuses medical and tactical emergency best practices. Our focus was on training the public on what to do to save lives before professional first responders arrive during medical emergencies. We piloted the program for youth and adolescents with Mr. David Beshk, an award-winning teacher who 3 days after beginning to learn rescue skills saved the first life. Under the great leadership of Mr. Beshk, we taught rescue care at a Med Tac after school club, summer school programs, and at special events. The training program was tremendously successful; however, we realized there was a public need for rescue gear and supplies if they were to save the most lives. My Eagle Scout Project was placement of the first rescue station at a beach where I lived. A bystander used the gear saved a life just 3 months after I installed it. So, I launched the Adopt a Cove program that has now expanded from coves to schools, colleges, parks, and youth camps. We have trained instructors in 5 states and are expanding to 7 states by 2024. Our team won the *Pete Conrad Global Patient Safety Award*ⁱ, and I was the student speaker at the NASA Kennedy Space Center. Our success and our running start in Southern California are in no small part due to Mr. David Beshk.

SARA VAUGHN

Driven by my love of the ocean, I launched the *Ocean Rescue Our Ocean* program.ⁱⁱ A non-profit initiative, it combines our Med Tac Bystander Rescue Training with ocean threat early warning tactics beachgoers and surfers can adopt. Participants learn how to save the lives of medical emergencies at the beach and how to be part of the early warning system to help identify emergencies that can harm the ocean and coastlines such as oil spills, erosion, and water quality issues. I had the honor of partnering with the *Surfrider Foundation* to deploy *The Be THE FIRST Responder* training program to its 200 global chapters and clubs.ⁱⁱⁱ We launched the program at the *Ocean Institute* in Dana Point California where I have been serving as an Ocean Safety Intern. Sarah Vaughn is an oceanographer and the director of the *Ocean Institute*. She is a terrific example of a wonderful environmental scientist who runs a world class training center and institute on the ocean. She has taught me why oceanography is a terrific discipline at the intersection of analytics, biology, and physics. She is proof positive that environmental scientists need a balanced toolbox of knowledge and skills. She welcomed allowing one of my high school student team to install two bystander rescue stations including AEDs and Stop-the-Bleed rescue gear at the *Ocean Institute* because a few short months into her leadership role there she helped save a life at the adjacent beach using an AED.

PROFESSOR TRAVIS WILLIAMS

Professor Williams inspired this article, and his advice has had an enormous impact on the trajectory of my academic career. I met Professor Williams at the *University of Southern California* when I was pursuing an opportunity to place bystander rescue stations at a youth camp on Catalina Island, approximately 30 miles off the coast of southern California where I live.

Dr. Travis Williams is a USC Professor of Chemistry where his research interests are studies of organometallics and catalysis and are applying them in projects ranging from designing new catalytic systems for synthetic fuels and fine chemicals to reclaiming value from waste polymers and materials. He is not only a world class scientist, but a mentor of youth and young leaders. He established the scientific training and staffing for a youth scout camp on Catalina Island where I wanted to place a bystander care rescue station. When our Med Tac Team learned about his plastic reclamation research of ocean plastics and microplastics with students, we proposed to produce a documentary to help educate students and the public about his great project that reclaims plastic and converts it into antibiotic building blocks that save lives. It is an exciting story about the discovery of a fungus in a high radiation area at Chernobyl that was then studied by USC Professor Clay Wang, Professor Williams research partner on the international space station and found to consume plastic producing valuable building blocks necessary to produce lifesaving antibiotics. We filmed Professor Williams on Catalina Island teaching young people how to collect plastic and then later at the *Ocean Institute* where I am an ocean safety intern.

The full-length documentary is in the pipeline, however I co-produced and helped narrate an initial short film entitled *Med Tac Minutes: Ocean Reclamation of Microplastics* describing his research.^{iv}

In developing the microplastics documentary, there were a couple of big surprises – one was exciting to me and one was scary. The scary one led me to write this article. The exciting one was how the knowledge and skills students can learn from the STEAM disciplines could help reclaim microplastics from the ocean. The scary one was that if I was not careful about my course choices, I might not have what it takes to contribute to the environmental solutions that could save the ocean that I love.

THE PROBLEM

The boundaries of environmental science are defined in a variety of ways. One such description defines it as “an interdisciplinary academic field that integrates physics, biology, and geography (including ecology, chemistry, plant science, zoology, mineralogy, oceanography, limnology, soil science, geology and physical geography, and atmospheric science) to the study of the environment, and the solution of environmental problems.”^v

For our feature length documentary, I had the opportunity of interviewing Professor Williams, David Beshk, and Sara Vaughn.

SOME COLLEGE STUDENTS IN ENVIRONMENTAL SCIENCE STUDIES ARE ILLEQUIPPED

I use my focus on oceans as an example of what we found is a shortcoming in college students pursuing an education in environmental science. The complex problems of climate change, rising seas, rising ocean temperatures, change in the pH of sea water, and damage to the ecosystems along our coastlines require far more than understanding than one focus area. For instance, in my case, being able to be a contributor to solve problems related to the ocean will require far more scientific knowledge than just marine biology. Environmental Scientific problems require that students have a broad range of analytical stools and know how to be contributors on multidisciplinary teams.

Charlie Denham: Professor Williams, what is the biggest challenge are you experiencing in working with environmental science studies students?

Professor Williams: “We have been surprised to find that college students in environmental science do not have the foundational concepts and tools necessary to work on the complex problems we face such as our work in ocean microplastics reclamation. They are missing the STEM fundamentals they need in order to work with us in our field of chemistry and our projects requiring the analytical know how and skills”.

In further discussions with Professor Williams, he shared that the Environmental Engineers do have the robust knowledge and skills necessary to be valuable contributors. So, it is not all of the environmental science students that come up short.

ENVIRONMENTAL SCIENTISTS NEED A BALANCED TOOLSET

In our discussions with Professor Williams, we dug into specific concepts, tools, and resources students need to become environmental scientists:

- **A General Interest in Science is Not Enough:** The interest in science broadly is not enough nor is a single focus on one area of environmental science going to give students the best opportunities in the future.
- **Technology Savvy:** Many believe that technology refers to narrowly devices, however Oxford Dictionary defines it as the application of scientific knowledge for practical purposes, especially in industry. The tools of environmental scientists are enabled by technology including best practices, use of devices, and new innovations in information science such as artificial intelligence. They must have the tools necessary to perform comprehensive analytics. This does not mean they will need to know how to write software, but they need to have the critical analytical and computer skills to do the work using technology.^{vi}
- **Engineering and Design:** The American Engineers' Council for Professional Development defines

engineering as “The creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property.”^{vii} According to Professor Williams, environmental scientists will need to understand how to work with engineers and how to communicate with them.

- **Mathematics:** It is said that there is no general consensus among mathematicians about a common definition for their academic discipline, however, has been described as is an area of knowledge that includes the topics of numbers, formulas and related structures, shapes and the spaces in which they are contained, and quantities and their changes. These topics are represented in modern mathematics with the major subdisciplines of number theory, algebra, geometry, and analysis respectively.^{viii} The tools of mathematics have to be in the toolbox of environmental scientists.

ADDING THE ARTS CREATES STEAM POWER

- **Art and the Arts:** Wikipedia defines the arts as “a very wide range of human practices of creative expression, storytelling, and cultural participation. They encompass multiple diverse and plural modes of thinking, doing, and being, in an extremely broad range of media.”

After learning from Professor Williams and from medical experts in the field of bystander rescue care how valuable communication is, I have a great appreciation for adding art to STEM in order to be a good contributor to environmental science. The art of storytelling, using digital media, and communication with those in my generation who are what people call “digital natives” who have grown up in the age of the internet and social media is very valuable. The internet has created a global community, and my love of learning Spanish has helped me communicate how to prevent drowning to Hispanic people in the United States and communicate with scientists such as I did on a summer project in Costa Rica studying replication of Sea Turtles. My appreciation for communication and demonstration helped me teach boat captains about bystander rescue care in Fiji where I surfed and enjoyed learning the culture. So, I believe in STEAM power and developing one’s STEAM engine for success will really work when the arts help empower communication.

THE SOLUTION

SEEK A RIGOROUS PATH

Students must select a thoughtful and more rigorous academic path in high school and college to really contribute to environmental science. Marine science and biology alone is not enough.

Professor Williams: “We need passionate, invested STEM professionals across all these disciplines. And some of them are going to be molecular scientists like me. But equally important are going to be the entrepreneurs, the economists, the marine biologists that help quantify the problem, the manufacturing professionals who help engineer the processes. We need people at every step of that way? And we need everyone in the chain to

be conversant with everybody else? It's not good enough that you're a good economist. It's not good enough that you're an MBA. You've got to be an MBA that can at least speak chemistry? You've got to be a marine biologist that can at least speak genetics to really put the puzzle together".

START EARLY OR RISK FAILURE

Students will have to balance their academic trajectory with their ability to get great grades and have the rigor necessary to get good reference letters and write compelling essays to earn admission to the best colleges.

The earlier students are motivated and know how they will be measured as college applicants the better. They need to know what courses are required to access the more comprehensive STEAM related academic tracks.

Professor Williams: "I understand that a more rigorous route may take more time, effort, and students may have to start early. However, in the long run it will pay off for everyone and give the students more real opportunities? I'm a chemist, I put molecules together. I speak molecular structure? It's really hard when you sit down to take high school chemistry and you're balancing salt metathesis equations and redox to understand how that's going to be important to you as an MBA or to you as a financier or to you as a mechanical engineer. But let me promise you it's vital? I speak that language well. I speak finance a little bit and the fact that I can play in the other guy's game I'm not no good at it But the fact that I can at least understand that conversation helps me put together the business infrastructure to bring solutions to life."

WORK BACK FROM SUCCESS

If I had it to do over again, I would have identified those courses that would help me pursue my dreams and deliver continuous community service that would be most valuable to me and to the colleges that I would pursue. I would have started earlier to look at the college programs in my interest area sooner. By working back from a successful path in environmental science, I would have made a better selection of courses for my junior year. Although I won the national *Surf Scholar of the Year Award and Scholarship* from the National Scholastic Surf Association during my junior year for having the highest GPA of competitive surfers, it is but one line item on my college application. Winning the *Eagle Scout Project of the Year* for my rescue station and for mentoring friends and teammates who saved lives from the training is just another line item. I love the Ocean and want to go to a great college and be a real contributor to environmental science solutions. If I had known what I know now I would have focused my environmental science activities earlier and delivered continuous hours of service and taken more two more AP courses in my junior year. I am catching up now with 5 this year because I want to earn the privilege to be a real contributor to environmental science.

WHAT IS YOUR MESSAGE FOR STUDENTS?

- **Professor Williams:** "Learn the language of science, technology, economics, entrepreneurship, and as much as you can so that you can be a full contributor to the solving these complex problems ^{ix}".
- **David Beshk:** "Lean into it. The path to be a great contributor to environmental science is not easy. You must lean into the hard sciences and have a firm understanding to be an effect an environmental science. It is a multidisciplinary endeavor so you will need a strong foundation in science, solid math skills, understand the implementation of technology, and how important engineering and design is to a growth mindset. Lean into it."

WHAT IS YOUR MESSAGE FOR PARENTS?

- **Professor Williams:** "Empower your kids. Let them know that they need to learn from all of their experiences, knowledge base, and relationships to succeed in the future".
- **David Beshk:** "Now we know you cannot let the motivated child to take an easier path. Encourage your child to be willing to take on difficult classes, become well balanced in all the realms of science. If they do, they will emerge with a good job pursuing what they love. They need the requisite skills, need to set real goals, and have a mindset to pursue excellence".

WHAT IS YOUR MESSAGE FOR EDUCATORS?

- **Professor Williams:** "I used to be a schoolteacher – teach them to not hate science. Teach them to love the game".
- **David Beshk:** "Challenge kids to challenge themselves to be great. They need to understand the path to success. Students often ask 'when I am ever going to use this Mr. Beshk? Educators need to have the answers to that question. They need to communicate how the scientific skills can transfer to success their long-term success and fulfilment."

THE ACTION PLAN FOR IMPACT

We use a framework of Head, Heart, Hands, and Voice to communicate how to drive action in the work we have undertaken with our Med Tac Bystander Rescue Training Program. I have used it below to describe how to generate the best impact. The potential action plan to drive impact by students, parents, and educators includes:

Head – What do we them to know?

- Since a more rigorous academic path will enhance a student's success, they must focus on multiple disciplines, start early in mapping their academic trajectory, and make sure they don't take a fork in the road that will limit their opportunities. The impact will be personal and perhaps even global.

Heart – What do we want them to feel?

- Students, parents, and their educators need to be inspired by the terrific broad range of opportunities to have impact on our planet from many different disciplines.
- Secondly, they must feel a sense of urgency about preparing for the future and not wait until their senior year in high school. They must work back from what will be required to earn acceptance by colleges that will develop the best career path for them.

Hands – What do we want them to do?

- Students and parents must talk to college counselors much earlier than their junior or senior year in high school about the process of applying for colleges. They must investigate and visit colleges that might give them the best opportunities in the future.
- Educators in as early as middle school should learn about the opportunities for their students and lay the groundwork for inspiring them to know that they can be a real contributor no matter what fields of study they may want to pursue.

Voice – What do we want them to share with others?

- Help others understand that their interests beyond just science may contribute to helping solve our planet's biggest problems.
- Talk to college students and professionals working in environmental science about what the evolving needs learn about the opportunities, knowledge, and skills they must have

to be a great contributor, win the competition for great jobs, and pay it forward by helping others up the ladder.

- Our Med Tac Team has used the expression “learn global, act local, and be vocal”. It fits.

I wish everyone with a passion for environmental science could have the benefit of the great mentors and advisors I have had. The future is not as scary as we think if we act now.

ⁱ https://en.wikipedia.org/wiki/Nancy_Conrad

ⁱⁱ <https://www.rescueourocean.org>

ⁱⁱⁱ <https://www.medtacglobal.org/be-the-first-responder-program/>

^{iv} <https://www.medtacglobal.org/oceanrescue/>

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https://en.wikipedia.org/wiki/Environmental_science#:~:text=Environmental%20science%20is%20an%20interdisciplinary,of%20the%20environment%2C%20and%20the

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<https://www.oxfordreference.com/display/10.1093/oi/authority.20110803102813387#:~:text=The%20application%20of%20knowle>
[dge%20to,in%20human%20interactions%20with%20nature](https://www.oxfordreference.com/display/10.1093/oi/authority.20110803102813387#:~:text=The%20application%20of%20knowle)

^{vii} <https://en.wikipedia.org/wiki/Engineering#Definition>

^{viii} <https://en.wikipedia.org/wiki/Mathematics>