The Occupy Mars Learning Adventures
By Bob Barboza, MS.
Our Barboza Space Center designs the software, robots, satellites, and science experiments needed for this project-based learning. Critical to the learning is the integration of Next Generation Science Standards, as well as the differentiation necessary to allow access for students at all levels of English fluency. Our resources are created to engage students in a simulated aerospace business, where they work in “Tiger Teams” to solve daunting problems from a variety of perspectives. Tiger Team members are trained to be experts in their specific focus areas and they advise their student colleagues on scientific and engineering matters that are critical to the simulated missions of the Barboza Space Center. In this way, students learn not only about exploring Mars, but also about how to make presentations, and how to market themselves and their ideas. In this context, as well as in the aerospace industry, biliteracy is clearly an asset.

Vital to every Super School Design Center project is a dedication to reaching students of a variety of ages and educational preparation. Just as our public schools accept all comers, so we take seriously our commitment to including not only English learners, but also students with special
needs, and at-risk students. We know from experience that giftedness cuts across all these categories and that we cannot afford to exclude anyone. Rather, it is up to teachers and parents to identify and build on the gifts each student brings. Curriculum is developed using the principles of understanding by design and differentiated instruction—a tall order, but one faced by every public school classroom teacher.

Our first Tiger Team was formed in June of 2017 with 10 high school students, most of whom were illiterate, attending the California Academy of Math and Science, in Long Beach, California. These students became Barboza Space Center Fellows, allowing them to study with a scientist and an aerospace engineer for four days. Students worked in pairs with an astronaut’s tool kit complete with robot parts, custom software, and tools for science, electrical engineering, and space mathematics. Their jobs included compiling glossaries of terms in Japanese and English, assembling and disassembling robots, researching alternate communication methods, and generating solutions to real problems faced in the aerospace industry—all under the constraints of time, accountability, and working as a multi-disciplinary “Tiger Team”.

The response to our first fellowship program was universal enthusiasm. Both students and their parents asked for more opportunities such as those afforded during the four days. Students relished the chance to apply their language and STEM knowledge to the solution of authentic challenges, to take on vital roles, and to work in a team environment. These “soft skills” are highly sought-after by prospective employers, who prize candidates able to work cooperatively in high-pressure environments. Our evaluations revealed the importance of forging a link between the learning taking place in the classroom and possible career pathways. Our plan is to extend the length of the upcoming fellowships to include even more emphasis on entrepreneurial skills and to award our next graduating fellows with letters of recommendation, aerospace patches, and certificates of program completion. We have plans to include new units to help all of our students learn how to learn when studying in the STEAM++ areas.

The notion of simulating work environments has broad appeal to a number of audiences, including members of the California Association for Bilingual Education, the Mars Society, Planetary Society, Robotics Society of Southern California and the National Space Society, the National Science Teacher Foundation, the California Science Teachers Association, Computer Using Educators (CUE), California Mathematics Council, and the California Association of Resource Specialists (CARS), all of whom constantly communicate about our projects. Book and research donations have poured in from the American Astronomical Society, the NASA Scientific Corporation, National Geographic, Pearson, and Wiley Publishing.

Future fellowship students will have opportunities to collaborate with students, teachers, and scientists both nationally and internationally. In the United States, our students and teachers collaborate with the USC School of Engineering, California State University, Long Beach School of Engineering and California State University, Dominguez Hills. To date, teams of parents and teachers in Australia, the Republic of Cabo Verde, and South Korea have expressed interest in collaborating via distance learning. Updates about these collaborations can be found on the following blogs:


Additional Barboza Space Center Projects

Robotics, Martian habitats, space mathematics, Martian science, the International Space Station Program, Kids Talk Radio Science, and arts-based creativity workshops figure among Barboza Space Center projects that are up and running or in the design stage. Descriptions of each follow:

Robotics. Our students have access to a wide variety of custom and commercial robots designed to support our Occupy Mars Learning Adventures. We use the Nao humanoid robot to teach programming and to simulate humanoid robots working on Mars. Twelve miniature Mars rovers, SCISAT robots, DoBot robot arms,
and Barboza Space Center cranes allow students to conduct science experiments. Training is underway for robotics interns from the engineering department at California State University, Long Beach, who will support high school Tiger Teams in solving technical problems involving advanced coding, design, and troubleshooting.

**Martian Habitats.** The rigor of the Martian surface, visited by fierce windstorms and bombardment from radiation, pose daunting challenges to those who would live there. Our habitat program integrates the physics, algebra, geometry and calculus needed to craft housing that is sustainable and sheltered from storms, extreme temperatures, and radiation. Using geometric shapes of cardboard and fiberboard, students are invited to devise prototypes of housing that could be assembled on or beneath the surface of the red planet. These habitats will house labs, living quarters, areas for growing food, rover storage, and the equipment needed to generate oxygen, power, and water supplies. In so doing, our students work alongside habitat designers and learn about mechanical drawing and space architecture by doing.

**Space Mathematics.** In addition to the math involved in designing habitats, students apply mathematics to the solution of problems like measuring time, gauging trajectories and spacecraft speed, and calculating ideal launch and landing sites. Each student keeps an astronaut’s notebook in both hard copy and electronic forms. Their notebooks compare to those kept by engineers in aerospace companies and are treated accordingly. In this way, students become aware of procedures followed by those companies, with respect to trade secrets and government security clearances.

**Martian Science.** Each student has an opportunity to explore an area of focus in science related to Mars, including robotics, measurement, motion, force and motion, work and energy, temperature and heat, waves and sound, optics and wave effects, electricity and magnetism, atomic and nuclear physics, chemistry, geology, and astronomy. State-of-the-art texts, distance learning, and consultation with working scientists provide the information needed to invent and create. Students take responsibility for teaching what they have learned to others on their team, providing a sense of community, as well as opportunities to learn and practice presentation skills.

**International Space Station.** Traveling on the International Space Station (ISS) requires re-thinking all aspects of living and working. On an eight-month journey to Mars, astronauts will need to produce food, work with special tools using space gloves, adjust their visual perception, keep their bodies healthy, and collaborate with people of other backgrounds—all while working in low and gravity-free environments. The knowledge needed to do this springs from myriad disciplines, including engineering, psychology and group dynamics, medicine, botany, computer and foreign languages, physics, and chemistry. By grappling with these challenges, students once again are invited to learn and apply the knowledge they need to craft workable solutions.

**Kids Talk Radio Science.** Teaching is one of the most powerful means of consolidating new learning and fosters many of the employability behaviors needed to land and maintain jobs in the aerospace industry. Accordingly, students are expected to create text, audio and video podcasts, as well as PowerPoint and other presentations. Their work is disseminated nationally and internationally on Kids Talk Radio Science, a cyber radio station linked to a network of STEAM++ students and professionals. Links to Kids Talk Radio Science channels are listed in this document.

Among our international partners is a team of students and educators in the Republic of Cabo Verde (RCV). Situated on a desert archipelago composed of live and dormant volcanoes off the coast of West Africa, the RCV enjoys a culture of leaders highly committed to developing leadership among its youth. Students in one high school on the Island of Fogo have already used Barboza Space Center kits to construct simulated Mars rovers. With the support of former President Pedro Pires, they are in constant communication with us and poised to continue our collaboration.
The mission of the Future-U-Community in Australia is to work out what education might look like on Mars 30 years into our future. The vision of Founder Jona Nalder is broad in scope and engages our students in imagining ideal learning environments.


**Barboza Space Center Creativity Workshops.**
Music and Fine Arts provide platforms, not only for imagining what could be, but also for expressing the new ideas that issue from students' work. Moreover, the lives of today's students are filled with music, albeit in non-traditional forms, and the art of graphic novels, video games, and animated movies. Integrating the arts, therefore, makes sense as a means of motivating and inspiring the study of STEAM++ related topics. The Barboza Space Center maintains a steady commitment to including the arts in all its endeavors—from an Occupy Mars Sound Effects Orchestra to the painting of life very different from our own.

**Conclusion.** A recurrent challenge for educators in our time is linking school-based learning with the world of work. Carving out career paths for a wide variety of students—from gifted to at-risk—is a high priority for federally and state-funded collaborations between business, community college, and high schools. We are all well aware of the destruction that results when disaffected youth see no purpose for learning or working, other than to survive. A trademark of the work of the SSDC and the Barboza Space Center is creating strong linkages with career pathways. Threaded throughout each project is an emphasis on the soft skills (working cooperatively, communicating clearly, learning from others' points of view, taking responsibility for others) that can tip the scales favorably in interviews and work environments. Our economy needs passionate, resilient and empathic workers, well-grounded in their disciplines, but willing always to see the world with new eyes. We cannot afford to waste one life, be it that of a student with meager preparation, one struggling with trauma, or another identified as autistic, gifted, or learning disabled. By providing the resources for high-motivational, project-based learning, as well as growth in citizenship, to teachers and parents in our country and internationally, we aim to help create a better world.
Training Jr. astronauts, engineers and scientists to work with humanoid robots on the Occupy Mars Learning Adventures
Students working at the Barboza Space Center are learning how to use Dobot robots to work on project-based learning associated to The Occupy Mars Learning Adventures. Students are simulating conducting science experiments on Mars.
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