Crossing the Channel, Testing the Waters

student research at sea

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The Bill of Rights graces the Oxnard waterfront and Santa Barbara Channel with the charm and character that only a tall ship can give. She brings our imagination back to the history of our state, when schooners and square riggers filled the harbors with a world eager to find the fortune of California. Today, every house on the waterfront benefits from the sight of a tall ship going out to sea or returning from her voyage, in many ways forging the connection between our history and our modern lives today.

But this wooden schooner is not only a pretty face; she is an active boon to the community. In addition to community service –including sails for scouts, public tours, schools, and veterans— The Bill of Rights is part of our country’s mission to improve science education. She provides a platform **for** university programs, carrying students doing scientific field research out into the Channel, where they learn to perform tasks in conditions more challenging, changing or perplexing than they could find in the classroom.

In the first week of April, nineteen students from California State University Channel Islands joined the schooner *The Bill of Rights* on a two-day mission to Santa Cruz Island and back, sampling the waters of the Channel along the way. Led by Professors Christopher Cogan and Blake Gillespie of CSUCI, and Professor Uta Passow of UC Santa Barbara, they were learning to read the story told by the chemistry, biology, and physical characteristics of our oceans.

At sea, their impromptu ocean laboratory is the deck of the schooner, where they have stowed bins of equipment –including carefully calibrated instruments for examining water samples, and rugged laptop computers for collecting and analyzing data. A large microscope is lashed to a table below. Students are climbing down steep ladders, stowing their gear in assigned sailor bunks in shared cabins under the heavy wooden beams. The authentic, traditional construction of this ship is a fantastic backdrop for modern scientific research.

On this voyage, Captain Stephen Taylor gracefully motors the ship from the early morning calm of the harbor and heads her directly for the first sampling station above the outlet pipe of the local power plant. He parks here so the class can test the waters for phosphates and nitrates, phytoplankton, pH, temperature, oxygen levels, etc. These readings will be followed by data gathered from eleven other locations in the Channel. The students are eager to find out how it compares. In the end, their data should come together to tell the story of what is happening in the water –a story we need to know in order to live with the sea, benefit from its bounty, and find out what part we can play to keep it healthy.

This first station is a bit awkward, as students struggle to make sense of new instructions, using unfamiliar equipment, sampling waters which don’t necessarily give expected values. Yet not one student looks bored, disengaged, or hopelessly frustrated. Instead of giving up they are intently studying their notes, asking questions, sampling buckets of water, filtering, reading equipment, entering data… The intensity of student focus in the field, itself, might be reason enough to make this kind of program a more integral part of education at all levels. Task by task the students are gaining confidence and ease with the work. Professor Passow remarks that she can measure a class by the amount of energy required to get them going and keep them on task. This class, she says, is a delight.

Despite the learning curve, it is easy enough to gather and analyze samples in the fairly calm waters. They are hard at work, even if the gentle roll of the ship adds a bit of green to a few cheeks. The class pauses only to admire a sunfish lolling in the waves, and they head back to their tasks as it bobs out of sight.

Soon winds pick up and the crew comes to life, raising sail. The schooner leaps forward. When we hit the higher seas of the Channel itself, the ship heels heavily and it is nearly impossible to stand, much less walk. Doing science gets a bit more challenging. I wonder whether the students will wait for calmer seas, but no: with the ship heeled about 45 degrees to the port side, they persevere.

The student entering data has braced herself against the housing, still filling in boxes on spreadsheets. Another is tightly gripping the high rail with his left hand, filtering his plankton sample with the right, while the lee rail is dipping into the water and foam is rushing in through the scuppers. The advantage of being on a tall ship in these seas—she heels only to one side. Students have wedged themselves against deck boxes, kneeling, still taking oxygen readings and holding spectrometers up to the light. Professor Blake carefully moves forward on a mission to rescue a box of vials and pipettes sliding across the deck.

Students are flashing smiles and laugh even harder when a wave breaking against the side splashes sea spray over them. They guard their buckets with their bodies, lest the wave should mix with the water sample and change the readings. The whales suddenly breaching off the starboard bow are more successful in distracting the class, bringing all other activity to a halt as some of us admire our first view of these leviathan creatures.

Down below the microscope waits, securely lashed and ready. This examination of water samples will have to wait for calmer waters –when we anchor— because the samples would slosh about the dish, or the inevitable pitching of the ship could give a black eye to someone peering into the eyepieces.

The students –today scientists at sea—not only gather active data, but they also find themselves in the midst of fantastic diversions which drive home the importance of their work. They are interacting with the very creatures that are affected by changes in the sea. It is a quick jump to realize that these creatures are not the only ones who care what is happening in the oceans, and who care whether the systems are healthy or not. We are a people who love to eat seafood, love to play on the beaches, who love fishing and surfing, love to watch the dolphins play in the waves. We like to breathe fresh air. Next distraction: a loaded tourist vessel passes by, headed to the islands: these visitors are even more reason to study and understand these waters.

High winds or calm seas, the science must go on. One cannot only sample the easy spots and expect to get a clear story of what is happening. It is a good thing the students persevere, because the difficult seas cause a curious effect on the results.

By the end of the day the class had indeed discovered a story to tell. Information that was perplexing in isolation became clearer as the data came together. Phytoplankton make oxygen, so why were the oxygen levels so high, when the phytoplankton levels were so low? Why so many zooplankton? Why the high pH? How does this relate?

It all points to a phytoplankton bloom several days ago. If one bit of information had been different, they would have had to search for a different answer. But experience and science tell this story: the phytoplankton bloom used up carbon dioxide, increasing pH and producing oxygen in the water. Then the zooplankton came in and began to feast, and the numbers of phytoplankton decreased as they were eaten. Others simply died and became marine snow, gently drifting down to nourish the lower layers of the sea. The samples were filled with detritus, waste, bits of non-living organic matter. When the wind and waves stirred the waters, the supersaturated water released its oxygen into the atmosphere –much like shaking a bottle of soda and releasing the fizz – making the air we like to breathe.

Phytoplankton are amazing organisms. They can move and look like animals (mostly like Pokémon, to be honest), and yet they are plants which photosynthesize. And that photosynthesis is what keeps all of us breathing, even more than all of the forests of the world combined. The health of the phytoplankton is of immediate interest to the health of humanity and all living things on the planet. And these tiny organisms are fascinating under a microscope. The first time I saw them under a microscope, I felt as though I had a window onto an alien world –and yet they are the most common living things of all, right here on earth. They spin, have spines, look like building blocks, slices of orange, spinning wheels, squiggles, lanterns, or resemble slices of pizza. The variety and color is stunning.

All this we can learn from a sample of water drawn up over the side of a ship. The students doing this are engaged and inspired, and taking the first steps toward their own capabilities as scientists. More serious research requires more serious equipment, but with a limited budget we begin with a simple bucket. That bucket, combined with experience, education, training, equipment and good minds leads to an understanding of what makes our planet work.

*The Bill of Rights* and her company of sailors and scientists anchor for the night at Santa Cruz Island. In the morning, early risers watch the birds fish as dawn turns the waters purple and the stars disappear. The trees and grasses of the island glow in the rising sun. After a hearty breakfast, Professor Cogan leads the class on a beach survey: recording the type and location of debris they gather into bags for disposal back on shore. This is training for a larger mapping and cleanup project scheduled for the following Sunday, with EPA (Environmental Protection Agency) support.

The return trip yields calmer seas, and the ship sails easily on her course. By now, the students are confident, more independent and compile their data more skillfully.

Is this just a pleasure excursion disguised as science class? Hardly. This research could be done by professional scientists –and *is* being done by professional scientists– but what if we never took students out to learn how research happens? Voyages like this give them the experience and practice they need to become literate in science, to become competent scientists themselves. And even more, they are learning why ocean research is inspirational and compelling. They are learning why it is important.

Out there on the open waters, one realizes why all this matters. When you are out there, and those breaching whales interrupt the data entry, the winds are strong on your cheeks, a sunfish gazes up at you with one lazy eye; or under the microscope you find a world of rushing creatures in your own water sample… it all comes together in one living picture. Cause and effect are right in front of you. The need for further studies on what conditions affect these creatures, this living system, become­s clearer.

Here in the Channel, on a magnificent tall ship, the story of our oceans is being read. In order for us to benefit from this story, the science needs to be done here and now. What is happening in the sea matters in real terms, not just in policy or speculation.

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