Lab in a can: New robotic labs are now going mobile to collect ocean samples

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It looks a lot like a garbage can-–but it's actually a fully functioning laboratory, thrown overboard, to analyze water samples in the open ocean. One day, a machine like it might tell us whether a beach is safe for swimming or water is clean enough to drink. The so-called "Lab in a Can" is nicknamed ESP.

"The ESP is the Environmental Sample Processor. It is an instrument that collects water, allows you to extract particles, and use molecular probe technology to understand the presence of certain organisms and their activities," explains Chris Scholin, president and chief executive officer of the Monterey Bay Aquarium Research Institute (MBARI).

With support from the National Science Foundation (NSF), microbiologist Scholin and his team at MBARI created the portable ESP to work on its own so the researchers don't have to travel back to the lab every time they want to analyze samples they collect at sea. Using onboard robotics and half-dollar size reaction chambers--called pucks--ESP can do tests ranging from detecting microbes and toxins to basic DNA analysis.

"We have intake valves. We draw in seawater with a syringe and create a vacuum to basically pull the seawater through a filter that collects a particular size of particles," explains marine biologist Christina Preston, pointing to the different parts that make up ESP. "We have a manipulator arm and a carousel that basically drives pucks in different places in order for us to complete our tasks."

"The ESP has enough battery power to last roughly 30 to 45 days," says Jim Birch, director of the Sensors Underwater Research of the Future (SURF) Center at MBARI. "Our goal is to have something that can go out for six months."

Researchers say an ESP network might one day crisscross our oceans, monitoring for problems such as oil spills. ESPs might also be used on farms to detect microorganisms like salmonella in the water that's used to hose down crops.

"Wouldn't it be great if we could detect out in the field before it gets into the packaging plant and onto people's table? We want to provide that early warning system," notes Chris Melançon, founder and CEO of Spyglass, the exclusive commercial partner of MBARI for the ESP.

"Science Nation" caught up with Melançon as he was introducing ESP to fish farmer Chris Newman, creator and president of Santa Cruz Aquaponics. Newman raises both watercress and carp in a closed loop water system to reduce the farm's impact on the environment. Water is pumped from fish tanks to watercress beds located above the fish tanks. The water is filtered and cleaned by bacteria in the rocks and watercress roots, and then pumped back into the fish tanks.

"All people who do aquaculture have to test water every day," says Newman. He is testing ESP to see if it accurately detects bacteria.

"Water quality testing takes an immense amount of time," he explains. "If you get it wrong, a whole bunch of fish can die on you. If you have something like ESP that gives you a database that comes up on a computer screen where you can just look at what your water quality is without having to go out and test, it's revolutionary!"

"It's the kind of device that could be in a water distribution center, in

reservoirs, or it could be on beaches or in the back of a van driving around for water quality assessment," says Scholin.

Scholin's work is funded under the American Recovery and Reinvestment Act of 2009 (ARRA). "The ARRA funding has been instrumental in helping to transfer ESP technology from MBARI to other researchers, not-for-profit organizations and government agencies," says Scholin. "It was the catalyst that made it possible to commercially manufacture a suite of ESPs. That first step has in turn spawned a new industry that aims to merge the fields of environmental monitoring with biomedical diagnostics. Nothing like this has ever been attempted before on any appreciable scale."

Now Scholin's team is working to pair ESP with an autonomous underwater vehicle (AUV), so the instrument can go mobile. You might call it "Lab in a Can" 2.0.

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