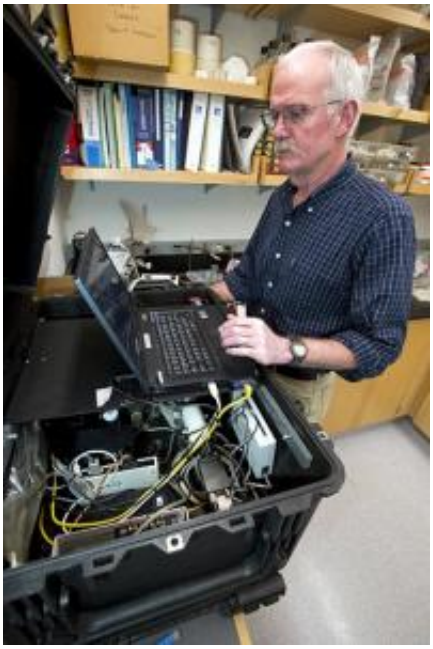
Swimming microbes monitor water quality

February 16 2011, By Peter Gwynne



Scott Gallager works on the swimming behavioral spectrophotometer to analyze the safety of a water sample. Credit: Tom Kleindinst Copyright Woods Hole Oceanographic Institution (WHOI)

Miners used to rely on canaries to alert them to dangerous build-ups of gases. Now much smaller animals -- the smallest of all -- can warn of toxins in water supplies.

Single-celled creatures called protozoa provide the warning when they change the way they swim. If efforts to develop the patent-pending technology succeed, the "swimming behavioral spectrophotometer", or

SBS, could be coming to a water supply near you.

The SBS, said inventor Scott Gallager, an associate scientist at the Woods Hole Oceanographic Institution in Mass., can potentially "monitor all the drinking water in the world."

To facilitate that goal, local start-up company Petrel Biosensors, Inc., has licensed the technology.

"Once we have financing, it will take between 12-15 months to get to a commercial product," said CEO Robert Curtis.

Visible only through a microscope, protozoa are covered in hair-like projections called cilia. In clean water, cilia propel the protozoa forward by working together like the oars of a rowing team. Pollutants in water can interfere with the movement of calcium through the microbes' bodies to the cilia. That alters their owners' swimming styles. The protozoa might spiral out of control or careen erratically around their tanks.

Different pollutants impact the swimming styles in identifiable ways. And various types of protozoa react to specific pollutants and other toxins in different ways. By using just a few types of protozoa in the SBS, scientists can trace a wide range of impurities, including pesticides, heavy metals, and biological warfare agents.

Between 50-250 protozoa are placed in the water to be tested, in a chamber about the size of a container for emergency gasoline. A camera records their movements for any time between 10 seconds and a minute.

The camera then feeds the images to software that evaluates about 50 characteristics of the microbes' swimming. The software determines the purity of the water sample by comparing the characteristics with those of

protozoa in distilled water.

The SBS uses a colored light system to reveal the water's quality. Green indicates that the water is safe, yellow calls for further testing, and red indicates danger, meaning, don't drink the water.

Gallager and his colleague Wade McGillis, now at Columbia University's Lamont-Doherty Earth Observatory in Palisades, N.Y., developed the SBS with a grant from the Defense Department.

"The technology is very quick; it monitors in real time," said Curtis. "It's got a great ability to detect a broad range of contaminants."

The SBS remains in a pilot stage. Eventually, Curtis expects to miniaturize the device and that each test will cost $1-2, in contrast to the $50-250 per test for existing methods. He also claimed the test will reduce the response time and the number of false positives and negatives.

One reason for the high cost of current methods is that they are very labor-intensive, said Andrew Gottlieb, executive director of the Cape Cod Water Protection Collaborative.

"So anything that can give us a line on less expensive water quality monitoring is good," Gottlieb said.

Initially, Petrel Biosensors plans to use the technology to test discharges of industrial waste water and runoff from storm drains. "Then we'll target municipal drinking water and military installations," Curtis said.

Another potential application: rapid testing of water that engineers use in hydraulic fracturing of rocks in the search for oil and gas.

Provided by Inside Science News Service