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# Eureka!: Geobacter keeps on conducting

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Created 08/28/2009 - 09:00

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It's been a rigorous couple of months for Geobacter, the riverbed muck biologically capable of conducting electricity.

In University of Massachusetts professor Derek R. Lovley's lab, Geobacter has been training hard and pumping iron, literally, to increase its power output.

And those slavish five months are paying off. Using adaptive evolution as the regimen, and "pushback" volts as the apparatus, Lovley has trained Geobacter to increase its power output by eight times.

"It's kind of like weight lifting," said Lovley, a distinguished professor of microbiology. "You keep pushing on the greater weight and eventually you have the ability to push that weight faster."

Single-celled Geobacter directly produces electricity as part of its biological process. It uses its pili, long, hairlike strands about 20,000 times finer than human hair, to take in iron minerals and expel iron oxide and electrons.

The microbial fuel cells that conduct Geobacter's electricity consist of two electrodes: one that accepts electrons from the microorganism (the anode) and another that transfers electrons onto oxygen (the cathode). Electrons flow between the anode and the cathode to provide the current that can be harvested to power electronic devices.

Lovley hopes to one day use Geobacter fueled by environmental waste to run all kinds of portable electronics.

But first the output of the anaerobic microbe has to be pumped up.

To increase its yield, Lovley first tried tinkering with Geobacter's genetics. Using this method the best Lovley and a team of research scientists could do was increase output twofold.

"It really wasn't that successful," he said.

So Lovely tried another tack, evolution.

In nature Geobacter doesn't run into electrodes. In its natural environment Geobacter doesn't have much pressure on it to create electricity, so it did not develop strong electrical production capabilities.

Lovley decided to challenge Geobacter's power-producing threshold. As usual Lovley placed the Geobacter on a graphite electrode, providing acetate as food for the microorganisms. He then added a tiny, 400-millivolt "pushback" current in the electrode that forced Geobacter to work harder to get rid of its electrons.

In each experiment, he chose the microorganisms that were the best at pushing out electrons and bred more of them. In five months, Lovley had increased Geobacter's electrical output eightfold.

"We're certainly going to continue with this," Lovely said. "We're trying to get a little more clever about what could be a better selective pressure" to apply to Geobacter.

## **Dudes in gangland**

Gang members may seem like little more than rough, violent, criminals, but really they're just average Joes, according to Andrew V. Papachristos, a University of Massachusetts sociologist.

Papachristos has been studying gangs since the 1990s. His most recent research focused on the social order of gangland murders, who kills whom, when, where and why.

The results revealed a story of people seeking respect in an environment where few avenues for success emerge.

"Gang members aren't criminal masterminds. Some are, but not many. They're not psychopaths, they're not serial killers, they're just regular dudes," said Papachristos. "When you're shut out of mainstream opportunities, you turn to the street."

Papachristos said he hopes his research can help in decreasing gang violence. He suggests that instead of solely going after gang murderers and criminals, a network be formed to intercede and mediate gang violence before it takes place. Also, opportunities for educational and professional advancement have to be extended to disadvantaged children.

"Police look at very specific aspects of gang violence, drug cases and things like that - which they should do, but if our goal is to get rid of gangs, that's never going to happen, because gangs are not there to sell drugs," Papachristos said. "They are there for real basic reasons."

People, mostly teen men, join gangs for the same reason they join football teams and fraternities: for camaraderie and protection.

"Gangs arise to meet the fundamental needs of adolescents," Papachristos said.

Wrapped up in the gang code is the need for respect, something that on the street, can't be earned through good grades, a raise, or an award. It's mainly secured through violence,

Papachristos noted.

"A guy like me, I can get a Ph.D. I'm a pro, there's honor in that," Papachristos said. "But on the street the only way you can get honor is by showing it, and how do you show you're honorable? You stand up for yourself and your friends."

For his study Papachristos used incident-level homicide records from Chicago police. He mapped out and analyzed gang murders over several years to identify the root causes and places where the violence occurred.

He found most gang murders are about seemingly petty things: name calling, girlfriends or boyfriends, acts viewed as disrespectful. "We're very good at locking people up, and we should continue to do that when warranted, but it's not going to help in the long run," Papachristos said. "We need to understand why, despite all these major (jail) sentences, gangs are still doing this."

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