

Helping Chlorine-eating Bacteria Clean Up Toxic Waste

ScienceDaily (June 22, 2007) — Cornell researchers hope to learn how certain bacteria that break down pollutants do their job and then to make them more effective in cleaning up toxic wastes.

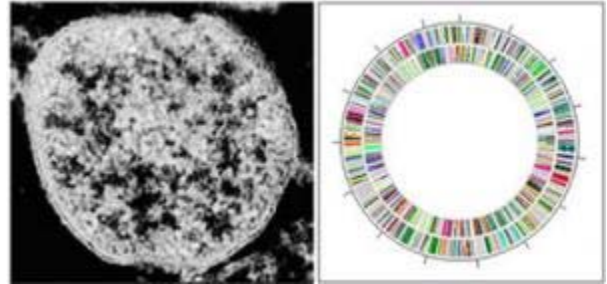
Bacteria called *Dehalococcoides ethenogenes*, discovered in Ithaca sewage sludge in 1997 by James Gossett, Cornell professor of civil and environmental engineering, and isolated and studied by Stephen Zinder, Cornell professor of microbiology, are now in wide use to detoxify such carcinogenic chemicals as perchloroethylene (PCE) and trichloroethylene (TCE). They do this by removing chlorine atoms from molecules and leaving less-toxic compounds behind.

But *D. ethenogenes* strains work well at some sites and not so well at others, and nobody knows for sure why. In fact, very little is understood about how these organisms live and breathe. Normal laboratory procedures haven't provided enough answers, because the bacteria are hard to grow in a petri dish, said Ruth Richardson, Cornell assistant professor of civil and environmental engineering, who is following up on Gossett's and Zinder's work, in continued collaboration with them.

She is partnering with Gene Network Sciences (GNS), a firm specializing in computer simulation of biochemical processes, to create computer models of the inner workings of the bacterium. The project is funded by a three-year, \$381,000 grant from the Department of Defense, which has some 6,000 toxic-dump sites of its own to clean up.

Richardson explained that in the field "the bacteria sometimes start and then stop. We might improve conditions for the organisms." For example, she said, it has been found that *Dehalococcoides* needs vitamin B-12, so the vitamin is added to cultures that are injected into cleanup sites. The bacterium also grows better in a mixed community with other kinds of bacteria. "There are some factors it needs from other organisms, and we don't know yet what they are," she said.

Her laboratory will test the *D. ethenogenes* strains under a variety of different conditions, such as exposing them to different chlorinated compounds one at a time, varying the environment or the nutrients supplied, and then observing which genes are expressed and what proteins are manufactured. The data will go to GNS, which will try to build computer models of how the bacteria's proteins work together under each condition and whether the pathway for each condition is the same for PCE and TCE,



*The bacterium *Dehalococcoides ethenogenes* can extract chlorine from chemicals to help clean up toxic wastes. Its genome (charted at right) consists of 1,640 genes. Cornell researchers hope to learn how these genes work together to process chlorine and find ways to help the bacterium do its job. (Credit: Image courtesy of Cornell University)*

and if not, what steps they have in common.

It will be an "iterative process," Richardson said. If a model shows that changing a particular condition produces a particular result, the lab will try it out and see if the result matches the model. Eventually, Richardson said, some commonalities should appear.

"There will be a suite of models, and we can highlight features that are common across several models," she said. "As we develop the model, we can begin to look at the genomes of other strains of *Dehalococcoides*. If genes that are important in our strain are found in others ... then we can do the same experiments with the others." Finding which genes are at work with which pollutants might lead to understanding how to remediate other kinds of pollutants, such as PCBs, dioxins, chlorobenzenes or chlorophenols.

Richardson, who grew up in the Hudson River Valley, notes that such pollutants are common in the river's harbors. "There are still thousands of sites around the country that need to be cleaned up," she said. "Ithaca has three or four, and that's not atypical."

Adapted from materials provided by [Cornell University](#).

Need to cite this story in your essay, paper, or report? Use one of the following formats:

APA

MLA

Cornell University (2007, June 22). Helping Chlorine-eating Bacteria Clean Up Toxic Waste. *ScienceDaily*. Retrieved July 2, 2008, from <http://www.sciencedaily.com/releases/2007/06/070620103258.htm>



Pollution-Eating Bacteria Gives Up Genetic Secrets

WASHINGTON - A pollution-eating bacteria first found in sewage sludge may have evolved its talents in response to human contamination of the environment, researchers said on Thursday.

They published the genetic sequence of the bug, called *Dehalococcoides ethenogenes* Strain 195, and said it showed some surprising flexibility.

"The genome sequence contributes greatly to the understanding of what makes this microbe tick and why its metabolic diet is so unusual," said Rekha Seshadri of The Institute for Genomic Research in Maryland, who helped lead the study.

D. ethenogenes, discovered by a team at Cornell University in New York, is being used at 17 polluted sites in 10 states.

Different strains break down perchloroethylene or PCE, a chlorinated solvent used for dry cleaning; trichloroethylene, used to clean metal parts; chlorobenzenes, used to produce the now-banned pesticide DDT; and polychlorinated biphenyls or PCBs, compounds that were once used as coolants and lubricants in transformers.

"Because chlorinated solvents have polluted so many water sources, there is a pressing need for new techniques to clean up such pollutants," said John Heidelberg of The Institute for Genomic Research, who has helped decode the genomes of other pollution-eating bacteria including the radiation-loving *Deinococcus radiodurans*.

The researchers, including teams at Cornell, Johns Hopkins University and Technical University in Berlin, found genes for 19 different reductive dehalogenases, enzymes that help *D. ethenogenes* microbe "breathe" chlorinated solvents.

It has clusters of genes called mobile genetic elements, said Cornell professor of microbiology Stephen Zinder, who named the bacteria after it was found in a sewage treatment plant.

"Just by picking up these mobile genetic elements from other bacteria, *Dehalococcoides* strains seem able to adapt and to take advantage of opportunities as they present themselves," Zinder said in a statement.

The researchers said their findings suggest the bacteria may have developed the ability to munch chlorinated solvents fairly recently, the researchers said.

Story Date: 7/1/2005

[Back to Top](#)

[Back to Headlines](#)

[See yesterday's headlines](#)