# UCSD biologists uncover the identity of a gene important in toxic waste removal

## June 15, 1999

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UCSD BIOLOGISTS UNCOVER THE IDENTITY OF A GENE IMPORTANT IN TOXIC WASTE REMOVAL

Moving closer to dramatic improvements in finding natural, biochemical tools for environmental waste clean up, researchers at the University of California, San Diego have discovered a gene that gives plants the powerful ability to detoxify heavy metals that are hazardous to human health and the environment.

More than a decade ago, researchers discovered that plants produce peptides called phytochelatins that naturally bind and detoxify dangerous toxic metals such as lead, mercury and cadmium. Phytochelatins mediate the accumulation of the bonded peptide-metal mix in the leaves of the plant, where they can be safely harvested.

Scientists, environmental engineers and others have sought the identity of the gene family responsible for producing phytochelatins in an effort to repeat and duplicate its naturally cleansing mechanisms.

Biologist Julian Schroeder and his colleagues at UCSD have succeeded in uncovering this genetic source, called "phytochelatins synthase" or PCS. The finding is described in the June 15 edition of the European Molecular Biology Organization (EMBO) Journal.

"We initially identified a PCS gene from wheat roots, but by looking into genome databases we found a sequence similar to PCS in the mustard plant Arabidopsis," said Schroeder. "We then tested the gene in Arabidopsis and, sure enough, it also detoxified the hazardous metal cadmium."

Schroeder's study included laboratory tests that demonstrated that cells expressing the PCS genes were dramatically more resistant to cadmium than those without PCS.

The researchers further used genome databases to successfully locate a PCS homologous sequence in a yeast species, called S. pombe. When the PCS gene was deleted from the genome of S. pombe, yeast growth was much more sensitive to cadmium.

Much to their surprise, the investigation also turned up a similar sequence in the genome of a worm, indicating that certain animals might also use PCS genes for detoxification of hazardous metals.

Researchers have sought the identities of gene families such as PCS in an effort to boost the ability of plants to detoxify metals at hazardous waste sites, a process collectively known as "bioremediation."

The U.S. government began targeting hundreds of hazardous waste sites in 1980 with the start of a "Superfund" program. Currently administered with more than $8.5 billion in taxes from petroleum products, the

Environmental Protection Agency program has listed more than 1,600 toxic sites around the nation. Of the ten leading Superfund toxic site contaminants, four are metals that interact with phytochelatins: lead, arsenic, mercury and cadmium.

Schroeder believes that the discovery of PCS is important for genetic engineering of plants to improve the potential of bioremediation.

"I believe that this gene, together with other genes that help detoxify metals in plants, will optimize the removal of metals in the future," said Schroeder. "You will never remove the metals completely out of hazardous waste sites, but these genes can dramatically bring down the levels of toxicity, hopefully to below hazard levels determined by the EPA which will reduce the health and environmental risks at these sites."

Schroeder also noted that two separate laboratories also identified the PCS gene during the same period as his UCSD laboratory discovered the gene. Those findings also are scheduled to be published. Under three different methods, the gene was uncovered by Schroeder, Dr. Rea of the University of Pennsylvania and Dr. Cobbett of the University of Melbourne in Australia.

(June 15, 1999)