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WHEN ELECTRONS CROSS MEMBRANES, THE WORLD CHANGES.

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When bacteria transfer electrons to metals, metal oxides can change in solubility, toxicity, or crystal structure. When bacteria transfer electrons to electrodes, we can power devices, sense biological activity, or coax salt ions to cross membranes and purify water. When one bacterium passes electrons to another, combinations of biochemical reactions are possible, such as diverting electrons from complex wastes into methane. While *Geobacter* are among the most ubiquitous bacterial groups involved in metal reduction, electricity production, and interspecies electron transfer, the genes and proteins enabling transmembrane electron transfer have remained a mystery. New efforts to expand the database of reference-quality *Geobacter* genomes and metagenomes using long-read sequencing reveal remarkable cytochrome diversity in these organisms. The use of 'Tn-Seq' saturation mutagenesis in *Geobacter,* along with markerless genome editing and inducible vectors, exposes a possible explanation for this diversity; independent cytochrome modules are required for electron transfer at different redox potentials, and to use different electron acceptors. For example, when *Geobacter* produces electricity, the pathway of electron transfer across the outer membrane utilizes completely different cytochromes compared to when *Geobacter* reduces metals. These results suggest it could finally be possible to untangle the biochemistry of extracellular respiration, detect metal cycling bacteria in the environment, use genetic information to discern the redox potential of a contaminated subsurface site, or design organisms specifically for electricity production via synthetic biology

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