These microbes 'eat' electrons for energy

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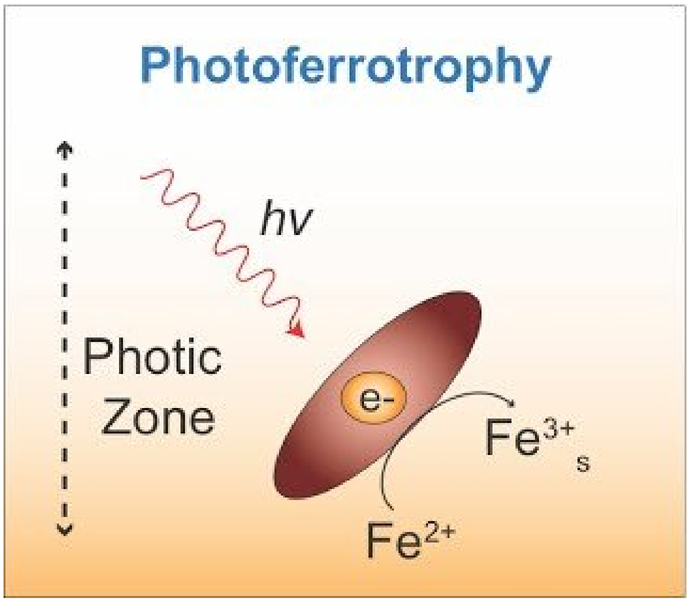

Photoferrotrophic organisms use light and electrons from the environment as an energy source. Credit: Duke Research Blog

The human body is populated by a greater number of microbes than its own cells. These microbes survive using metabolic pathways that vary drastically from those of humans.

Arpita Bose, Ph.D., of Washington University in St. Louis, is interested in understanding the metabolism of these ubiquitous microorganisms, and putting that knowledge to use to address the energy crisis and other applications.

One of the biggest research questions for her lab involves understanding photoferrotrophy, or using light and electrons from an external source for carbon fixation. Much of the source of energy humans consume comes from carbon fixation in phototrophic organisms like plants. Carbon fixation involves using energy from light to fuel the production of sugars that we then consume for energy.

Before Bose began her research, scientists had found that some microbes interact with electricity in their environments, even donating electrons to the environment. Bose hypothesized that the reverse could also be true and sought to show that some organisms can also accept electrons from metal oxides in their environments. Using a bacterial strain called Rhodopseudomonas palustris TIE-1 (TIE-1), Bose identified this process called extracellular electron uptake (EEU).

After showing that some microorganisms can take in electrons from their surroundings and identifying a collection of genes that code for this ability, Bose found that this ability was dependent on whether a light source was also present. Without the presence of light, these organisms lost 70% of their ability to take in electrons.

Because the organisms Bose was studying can rely on light as a source of energy, Bose hypothesized that this dependence on light for electron uptake could signify a function of the electrons in photosynthesis. With subsequent studies, Bose's team found that these electrons the microorganisms were taking were entering their photosystem.

To show that the electrons were playing a role in carbon fixation, Bose and her team looked at the activity of an enzyme called RuBisCo, which plays an integral role in converting carbon dioxide into sugars that can be broken down for energy. They found that RuBisCo was most strongly expressed and active when EEU was occurring, and that, without RuBisCo present, these organisms lost their ability to take in electrons.

This finding suggests that organisms like TIE-1 are able to take in electrons from their environment and use them in conjunction with light energy to synthesize molecules for energy sources.

In addition to broadening our understanding of the great diversity in metabolisms, Bose's research has profound implications in sustainability. These microbes have the potential to play an integral role in clean energy generation.

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