Odd energy mechanism in bacteria analyzed

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Scientists at Oregon State University have successfully cultured in a laboratory a microorganism with a gene for an alternate form of photochemistry – an advance that may ultimately help shed light on the ecology of the world's oceans.

The microorganism is SAR11, the smallest free living cell known and probably the most abundant organism in the seas. By being able for the first time to study the SAR11 "proteorhodopsin" gene in a laboratory, researchers will be able to better understand how it is activated, its role in the life and survival of SAR11, and how it affects ocean ecology. The findings are being published today in the journal Nature.

Surprisingly, the SAR11 bacteria continued to grow normally whether or not there was light available - indicating to OSU researchers that the cell does not require this energy producing mechanism in normal conditions. It's possible, they said, that this alternate form of photochemistry serves as a "backup" system to provide energy to the cells when they face starvation in the open ocean, which often has very limited nutrients.

"It's exciting to learn more about another form of photochemistry that does not use chlorophyll", said Stephen Giovannoni, a professor of microbiology at OSU. "This proteorhodopsin gene, however, seems to have a subtle role in the life and survival of SAR11, and appears to be an auxiliary system to aid cell survival."

The level of interest in SAR11 is high, researchers say, because it dominates microbial life in the oceans, survives where most other cells

would die, and plays a major role in the cycling of carbon on Earth. These bacteria may have been thriving for a billion years or more, but they have the smallest genetic structure of any independent cell and were only first discovered by OSU scientists in 1990.

Although tiny, because of their huge numbers SAR11 plays a major role in the planet's carbon cycle as a consumer of organic carbon. Its main energy generating system is the respiration of organic carbon, producing carbon dioxide and water in the process.

Oxygen in the Earth's atmosphere was largely created and is maintained by photosynthesis, in which plants convert sunlight into biological energy through a process that requires chlorophyll. In the oceans, SAR11 is a partner in this process, recycling organic carbon and producing the nutrients needed for the algae that produce about half of the oxygen that enters Earth's atmosphere every day.

The carbon cycle ultimately affects all plant and animal life on Earth.

However, it's now clear that SAR11 has its own mechanism to use sunlight energy that does not involve chlorophyll. Rather, it uses retinal, the same protein used by the eyes of animals and humans to detect light, and serves as a "proton pump" to energize the cell membrane. Proteorhodopsin was only discovered in 2000, but until now, it had not been found in a living organism. It's still not totally clear, Giovannoni said, how this energy producing mechanism benefits the cell.

"When we turned the lights off, there was no mechanism for the proteorhodopsin gene to produce energy, but that didn't seem to make any difference in the growth rate of SAR11," Giovannoni said. "So we know that under normal conditions this alternate form of energy production is not required. This system may be there for emergencies. But it may still be very important to ocean life, and that's what we need

to find out more about."

Source: Oregon State University