

New insight into biosynthesis and architecture of photosynthetic membranes in bacteria

June 10 2021

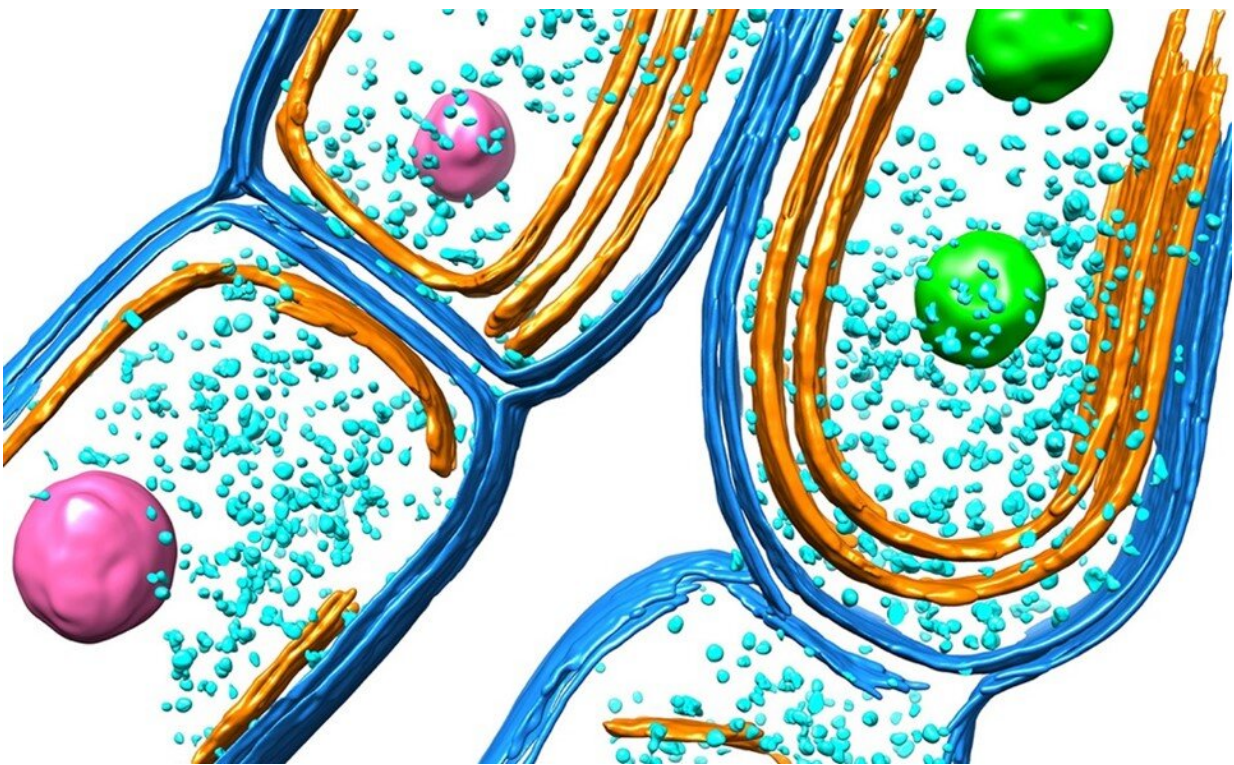


Illustration of the cyanobacterial thylakoid membrane. Credit: Luning Liu et al.

A new study conducted by the researchers at the University of Liverpool reveals how the ancient photosynthetic organisms—cyanobacteria—evolve their photosynthetic machinery and

organise their photosynthetic membrane architecture for the efficient capture of solar light and energy transduction.

Oxygenic [photosynthesis](#), carried out by plants, algae, and cyanobacteria, produces energy and oxygen for life on Earth and is arguably the most important biological process. Cyanobacteria are among the earliest phototrophs that can perform oxygenic photosynthesis and make significant contributions to the Earth's atmosphere and primary production.

Light-dependent photosynthetic reactions are performed by a set of photosynthetic complexes and molecules accommodated in the specialised cell membranes, called thylakoid membranes. While some studies have reported the structures of photosynthetic complexes and how they perform photosynthesis, researchers still had little understanding about how native thylakoid membranes are built and further developed to become a functional entity in cyanobacterial cells.

The research team, led by Professor Luning Liu from the University's Institute of Systems, Molecular and Integrative Biology, developed a method to control the formation of thylakoid membranes during [cell growth](#) and used state-of-the-art proteomics and microscopic imaging to characterise the stepwise maturation process of thylakoid membranes. Their results are published in the journal *Nature Communications*.

"We are really thrilled about the findings," said Professor Liu. "Our research draws a picture about how phototrophs generate and then develop their photosynthetic membranes, and how different photosynthetic components are incorporated and located in the thylakoid membrane to perform efficient photosynthesis—a long-standing question in this field."

The first author of the study, Dr. Tuomas Huokko, said: "We find that

the newly synthesised thylakoid membranes emerge between the peripheral cell membrane, termed the plasma membrane, and the pre-existing thylakoid layer. By detecting the protein compositions and photosynthetic activities during the thylakoid development process, we also find that photosynthetic proteins are well controlled in space and time to evolve and assemble into the thylakoid membranes."

The new research shows that the cyanobacterial [thylakoid membrane](#) is a truly dynamic biological system and can adapt rapidly to environmental changes during bacterial growth. In thylakoids, photosynthetic proteins can diffuse from one position to another and form functional "protein islands" to work together for high photosynthetic efficiency.

"Since cyanobacteria perform plant-like photosynthesis, the knowledge gained from cyanobacteria thylakoid membranes can be extended to plant thylakoids," added Professor Liu. "Understanding how the natural [photosynthetic machinery](#) is evolved and regulated in phototrophs is vital for tuning and enhancing photosynthetic performance. This offers solutions to sustainably improve crop plant photosynthesis and yields, in the context of climate change and growing population. Our research may also benefit the bioinspired design and generation of artificial [photosynthetic](#) devices for efficient electron transfer and bioenergy production."

More information: Tuomas Huokko et al, Probing the biogenesis pathway and dynamics of thylakoid membranes, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-23680-1](https://doi.org/10.1038/s41467-021-23680-1)

Provided by University of Liverpool

Citation: New insight into biosynthesis and architecture of photosynthetic membranes in bacteria

(2021, June 10) retrieved 26 April 2024 from <https://phys.org/news/2021-06-insight-biosynthesis-architecture-photosynthetic-membranes.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.