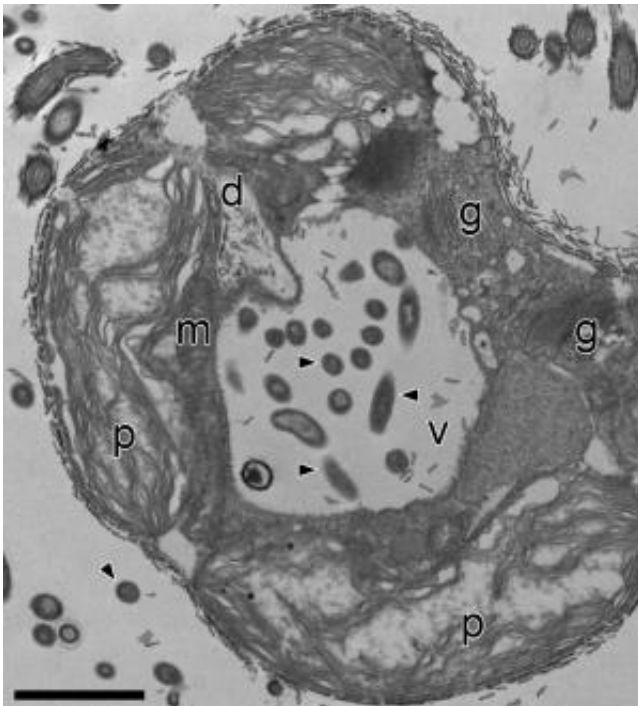


Scientists offer first definitive proof of bacteria-feeding behavior in green algae

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This transmission electron micrograph shows bacteria-feeding in the green alga *Cymbomonas*. In the cross-section features a large vacuole (v) containing bacterial cells. It also shows the tubular duct (d) that transports food into the vacuole. Other structures pictured are plastids/chloroplasts (p), a mitochondrion (m), and Golgi bodies (g). The scale bar represents 2 micrometers. Credit: AMNH/E. Kim

A team of researchers has captured images of green alga consuming bacteria, offering a glimpse at how early organisms dating back more

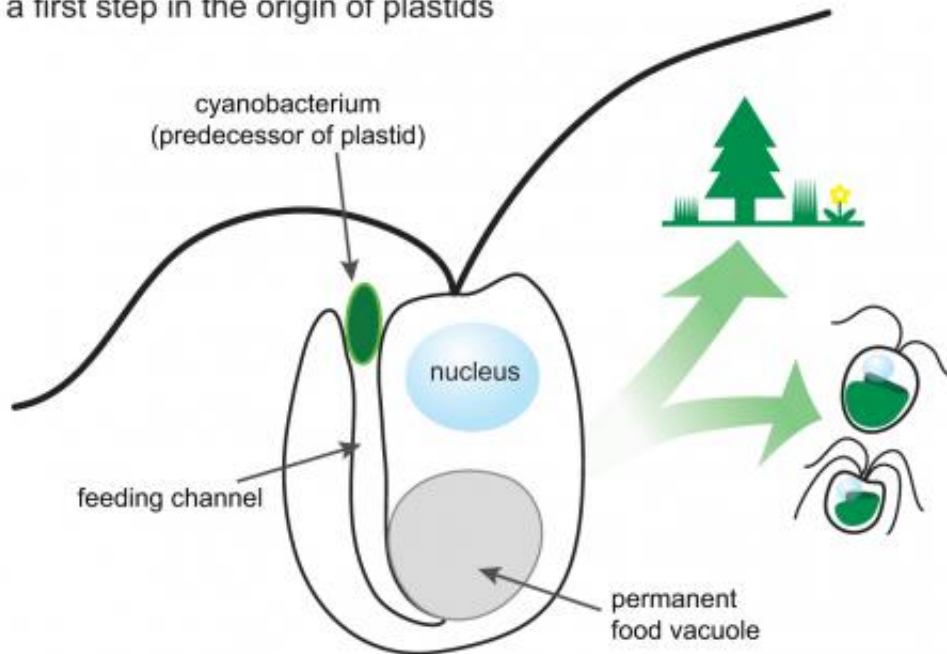
than 1 billion years may have acquired free-living photosynthetic cells. This acquisition is thought to have been a critical first step in the evolution of photosynthetic algae and land plants, which, in turn, contributed to the increase in oxygen levels in Earth's atmosphere and ocean and provided one of the conditions necessary for animal evolution.

In a paper that appears in the June 17 issue of *Current Biology* and is available online today, researchers identify a mechanism by which a green alga that resembles early ancestors of the group engulfs bacteria, providing conclusive evidence for a process that had been proposed but not definitely shown.

"This behavior had previously been suggested but we had not had clear microscopic evidence until this study," said Eunsoo Kim, assistant curator in the Museum's Division of Invertebrate Zoology and corresponding author on the paper. "These results offer important clues to an evolutionary event that fundamentally changed the trajectory of the evolution of not just [photosynthetic algae](#) and [land plants](#), but also animals."

In green algae and land plants, photosynthesis, or the conversion of light into food, is carried out by a specialized cell structure known as a chloroplast. The origin of chloroplast is linked to endosymbiosis, a process in which a single-celled eukaryote—an organism whose cells contain a nucleus—captures a free-living photosynthetic [cyanobacterium](#) but does not digest it, allowing the photosynthetic cell to eventually evolve into a [chloroplast](#). The specific feeding mechanisms for this process, however, have remained largely unknown until now.

Phagocytosis by an early eukaryote:
a first step in the origin of plastids



This illustration demonstrates the bacteria-eating behavior of green algae and the eventual evolutionary path it created for photosynthetic algae and land plants. Credit: AMNH/E. Kim and National Institute for Basic Biology/S. Mauyama

In this study, researchers used [transmission electron microscopy](#) and feeding and staining experiments to take conclusive images showing how a basic green alga from the genus *Cymbomonas* feeds on bacteria. The alga draws bacterial cells into a tubular duct through a mouth-like opening and then transports these food particles into a large, acidic vacuole where digestion takes place. The complexity of this feeding system in photosynthetic modern alga suggests that this bacteria-feeding behavior, and the unique feeding apparatus to support it, descend from colorless ancestors of [green algae](#) and land plants and may have played important roles in the evolution of early photosynthetic eukaryotes, the precursors to plants like trees and shrubs that cover the Earth today.



The green alga used in this study and shown here is from the genus *Cymbomonas*, which presumably resembles early ancestors of the group. The scale bar represents 10 micrometers. Credit: AMNH/E. Kim

Eunsoo Kim joined the Museum in 2012 as curator of the protist collection, which includes algae, protozoa, and fungus-like protists. A native of South Korea, Kim received her Ph.D. in botany from the University of Wisconsin-Madison and conducted postdoctoral research at Dalhousie University in Halifax, Nova Scotia. She works closely with associate curator Susan Perkins and curator Rob DeSalle as part of one of the first natural history museum microbial research programs.

Shinichiro Mauyama, currently a postdoctoral researcher at the Division of Environmental Photobiology at the National Institute for Basic

Biology in Okazaki, Japan, is a co-author on this paper. In addition to Kim's laboratory at the Museum, this work was conducted in John Archibald's laboratory at Dalhousie University. Funding was provided by the American Museum of Natural History and Japan Society for the Promotion of Science.

Provided by American Museum of Natural History

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