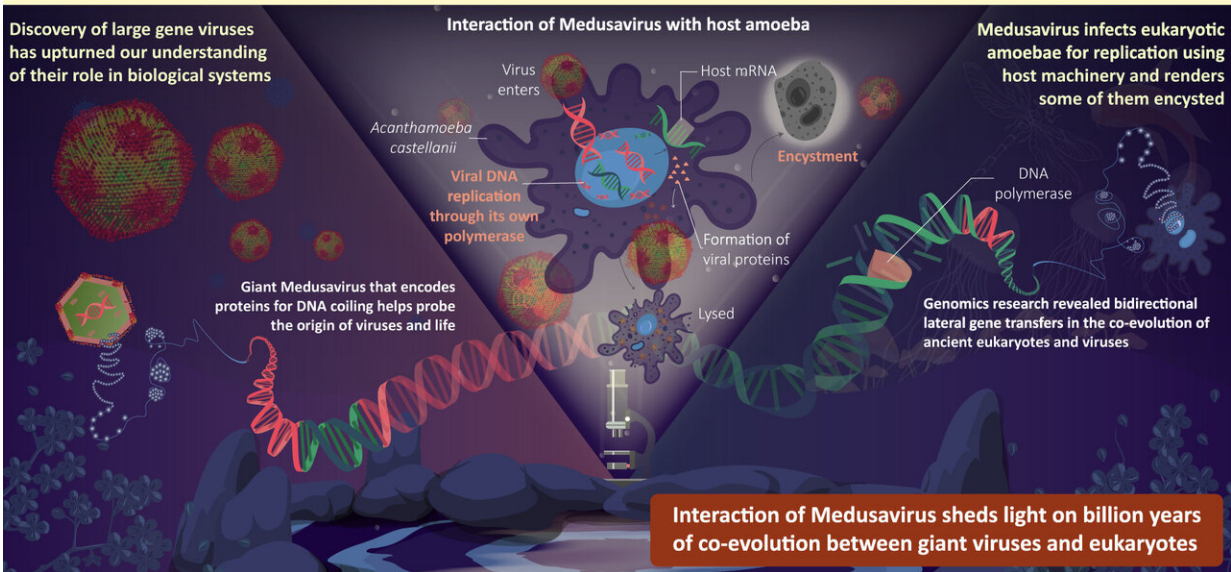


New giant virus may help scientists better understand the emergence of complex life

May 1 2019

Stranger than mythology: Giant Medusavirus casts a spell on the understanding of the evolution of life



The infographic is divided into three main sections:

- Left Section:** "Discovery of large gene viruses has upturned our understanding of their role in biological systems". It features a large, textured spherical virus particle and a smaller, more complex virus structure. Text: "Giant Medusavirus that encodes proteins for DNA coiling helps probe the origin of viruses and life".
- Center Section:** "Interaction of Medusavirus with host amoeba". It shows a cross-section of an amoeba cell. Labels include: "Virus enters", "Viral DNA replication through its own polymerase", "Host mRNA", "Encystment", "Formation of viral proteins", and "Lysed". The amoeba is labeled "Acanthamoeba castellanii".
- Right Section:** "Medusavirus infects eukaryotic amoebae for replication using host machinery and renders some of them encysted". It shows a DNA double helix and a virus particle. Text: "Genomics research revealed bidirectional lateral gene transfers in the co-evolution of ancient eukaryotes and viruses".

Bottom Center: "Interaction of Medusavirus sheds light on billion years of co-evolution between giant viruses and eukaryotes".

Bottom Left: 東京理科大学 TOKYO UNIVERSITY OF SCIENCE

Bottom Right: Medusavirus, a novel large DNA virus discovered from hot spring water
Yoshikawa *et al.* | Journal of Virology | April 2019 Volume 93 Issue 8 | DOI: 10.1128/JVI.02130-18
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A new giant virus may help scientists better understand the emergence of complex life. Credit: Tokyo University of Science

The discovery of the Medusavirus holds clues to the evolution of more complex life. A paper published in the *Journal of Virology* earlier this year has been creating waves because of the ability of the Medusavirus to turn amoeba into "stone." However, the bigger discovery is the possible relationship between the Medusavirus and the evolution of

complex life. Tokyo University of Science has released a video and an infographic to explain this phenomenon.

A team of scientists led by virologist Masaharu Takemura at Tokyo University of Science and Hiroyuki Ogata at Kyoto University in Japan have discovered a [giant virus](#) that, much like the mythical monster Medusa, can turn an [amoeba](#) into a stone-like cyst. Isolated from a hot spring in Japan and dubbed Medusavirus, this [virus](#) infects a species of amoeba known as *Acanthamoeba castellanii* and causes it to develop a hard, stony shell.

The scientists discovered that Medusavirus DNA replication occurred in the nucleus of the host amoeba and observed evidence of exchange of genetic information between the host and the virus as they co-evolved. They also found that the giant virus harbors in its ancient genome some of the complex proteins that make up the building blocks of eukaryotic organisms such as animals, plants and humans. Understanding the presence of these proteins in the virus' genome may help scientists tackle some of the hardest questions about our origins. "Genomics research of the giant virus indicates that there is likely a relationship between the Medusavirus and the origin of eukaryotic life," says Professor Takemura from Tokyo University of Science.

A virus does not have the necessary "machinery" to replicate. It leverages the genetic machinery of the host cell by releasing its genome and "hijacking" the host's machinery. When a virus invades an organism, it uses some of the host genes in order to replicate itself. This can leave a mark, like a fingerprint, on the host's DNA, which is then passed on for generations. The host also interacts with the virus, and the virus adopts new sequences that are preserved through time. The host and virus co-evolve, and it is this co-evolution that is at the forefront of this insightful study.

Viruses are classified based on their genetic characteristics, that is, by how they generate mRNA to produce proteins and genetic material. The Medusavirus is a nucleocytoplasmic large DNA virus, which belongs to a group of recently discovered eukaryotic viruses with large and complex double-stranded DNA (dsDNA) genomes. It is interesting because, unlike most viruses, it contains genes that encode for proteins involved in DNA packaging. The Medusavirus has a full set of [histones](#), which are proteins that have evolved to keep the DNA folded inside the nucleus and regulate gene expression. This is particularly strange when you consider that viruses have no nucleus; this could mean that during the co-evolution, the virus might have acquired the genes that encode these histones. With these findings, this study also makes a claim that the Medusavirus is a completely different family of viruses.

When the Medusavirus petrifies the amoeba, it does so by hijacking the cell directly from its nucleus. The virus transfers its DNA to initiate replication and uses its own DNA polymerase (an enzyme that synthesizes DNA) and histones, but overall, it relies on the host to complete the process. The results of an evolutionary analysis done by the authors suggest that in the [evolutionary tree](#), the Medusavirus DNA polymerase lies at the origin of the DNA polymerase found in [eukaryotes](#). As one of the authors, Dr. Genki Yoshikawa from Kyoto University, puts it, this could mean that our DNA polymerase "probably originated from Medusavirus or one of its relatives."

Luckily, the Medusavirus won't be turning us into stone anytime soon.

More information: Genki Yoshikawa et al, Medusavirus, a Novel Large DNA Virus Discovered from Hot Spring Water, *Journal of Virology* (2019). [DOI: 10.1128/JVI.02130-18](https://doi.org/10.1128/JVI.02130-18)

Provided by Tokyo University of Science

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