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## Origin and evolution of the viral supergroup

Arshan Nasir and Gustavo Caetano-Anollés  
University of Illinois, USA

Viruses are the most intriguing group of biological entities. They are infectious agents that are highly abundant and demonstrate a variety of replication strategies (i.e. RNA, DNA, and intermediates). Due to their pathogenic abilities and remarkable diversity, viruses are recognized as important contributors to our ecosystem, economy, medicine, health and evolutionary biology. Despite their significance to the biosphere, explaining viral origins has always remained one of the great unknowns in biology and a matter of great debate. Thanks to the recent advancements in genomics and structural bioinformatics, it is now possible to develop computational models that enable studying the evolution of viral supergroup on a scale comparable to cellular organisms. Here we propose a new model for the evolution of viral supergroup where modern viruses represent remnants of primordial cells that once coexisted with the cellular ancestor. Under this model, we envision a scenario where the last universal common ancestor (now redefined LUCA) gave birth to a number of descendant cells. These primordial cells represented experimental factories where different life experiments were tried out. From this pool of primitive cells, the two 'successful' lineages appeared: 1) the last universal cellular ancestor (LUCELLA) that discovered ribosomes and in due course gave rise to modern cells (i.e. Archaea, Bacteria and Eukarya), and 2) the ancient virocell that discovered capsids and eventually reduced into extant viruses. The persistence strategy for the ancient viral lineage was 'economy' and they traded off large genome sizes for acquiring remarkable pathogenic abilities. We thus propose an ancient (and possibly polyphyletic) origin for the viral supergroup from primordial cells that was governed by genome reduction. The evidence of this model comes from the observation that a large number of ancient protein domain structures are found in many viral genomes (indicating their coexistence with the ancient cells) and the link between genome reduction and parasitism has been established for many cellular organisms. This model is data-driven and accounts for the ongoing evolution of viruses from modern parasitic cells.

[anasir@illinois.edu](mailto:anasir@illinois.edu), [gca@illinois.edu](mailto:gca@illinois.edu)