



## Viruses – existence on the border between living and non-living

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There have always been disputes in the scientific community about the nature of viruses, specifically whether they are living organisms or just molecules. Although both sides make strong arguments, researchers have yet to agree. Some scientists claim that viruses are not living organisms, based on the following considerations:

- a) viruses are not capable of independent replication and depend on a cell to replicate;
- b) viruses do not have their own metabolism and do not have a cell membrane;
- c) they say that the fact that viruses reproduce is not an argument to consider them living organisms, just as neither plasmids, DNA, or prions are living organisms, even if they reproduce.

The other part of researchers believes, on the contrary, that viruses should be considered living organisms (Harris & Hill 2021), despite their particularities based on the following considerations:

- a) viruses are able to alter the architecture of the host cell, building organelles with which to replicate, similar to intracellular parasites;
- b) Nasir & Caetano Anolles (2015) concluded in a phylogenetic study that viruses and modern bacteria descend from common cellular ancestors (i.e, from living organisms). Therefore, viruses, which descend from living ancestors, cannot be considered non-living simply because they have regressed in structure over the course of evolution;
- c) the dependence of viruses on a host cell to live and replicate cannot be a serious consideration in categorizing viruses as non-living entities. Why? Because not only viruses, but most living organisms on Earth are totally or partially dependent on other organisms to live. For example, man, the most evolved being on Earth, is dependent on intestinal flora, while some plants are dependent on nitrogen-fixing bacteria;
- d) the argument that viruses are not living organisms because they do not have a cell membrane does not hold up: neither mitochondria nor plastids are alive, although they do have a cell membrane.

They say that only satisfactory definition of life therefore lies in the most critical property of genetic heredity: independent evolution. Life is the manifestation of a coherent collection of genes that are competent to replicate within the niche in which they evolve (d). Viruses fulfil this definition (microbiologysociety.org).

To clarify this dispute, it would be important if we knew with certainty the origin of all viruses (Moelling & Broecker 2019). Although viruses are mostly believed to be polyphyletic, they could have three completely different origins:

a) viruses may be the descendants of the first non-cellular entities that gave birth to life on Earth;

b) viruses could be descendants of cellular life forms, but which have regressed in structure through simplification;

c) viruses could be polyphyletic and descended from both cellular (living) life forms and non-living molecules that gave rise to life on Earth.

But answering this question is very complicated because non-cellular entities undergo accelerated restructuring of DNA and RNA, and phylogenetic studies cannot be very accurate (just as other life forms follow the principle of the "molecular clock of evolution").

**Conflict of interest.** The author declares that there is no conflict of interest.

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